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Mariners Weather Log

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Mariners Weather Log

Editor: Elwyn E. Wilson
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Cover: Typhoon Phyllis brought heavy rains and flooding to Shikoku, Japan, in August. Highways were cut off by flood waters hampering rescue work. (For details on Phyllis, see page 33.) Wide World Photo.

The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical approved by the Director of the Office of Management and Budget through June 30, 1980.

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Mariners Weather Log

HIGH WAVES IN THE AGULHAS CURRENT

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Editor's Note: The following is an additional article on high waves off South Africa. Mr. Schumann's article appeared in the South African Shipping News and Fishing Industry Review, March 1975, whom I thank for permission to reprint. I also wish to express my appreciation to Mr. C. P. Duncan for his additional comments and figures.

It is now well established that very high wave conditions occur regularly off the coast of South Africa. The mounting toll of ships damaged bears witness to this fact, and it is therefore necessary to examine probable causes, and, if possible, suggest ways in which ships can avoid these high waves or deal with them when they are encountered.

The analysis by Mallory (1974) of a number of ship casualties shows that it is the southwesterly waves moving up the east coast that cause the damage; for example the 258,000-ton SVEALAND on her maiden voyage in September 1973 encountered abnormal waves which set her first two hatches bodily down by half a meter and also injured two crewmen. The waves were generated by southwesterly winds blowing over long fetches to the south and east of South Africa, and Mallory suggests that in order to avoid this type of accident, ships should keep inshore of the 200 m (100 fm) line when these weather conditions prevail.

This 200 m line plays an important part in the discussion of high waves, not because it has a direct influence on the waves, but rather because it marks an approximate inshore boundary of the strong-flowing Agulhas Current. It is probable that it is the transfer of energy from the current to the waves that makes them into killers.

To get an idea of the change that can occur in a wave group moving into a strong opposing current region, figure 1 shows sections of wave records made by an NRIO wave recorder mounted in the hull of the research

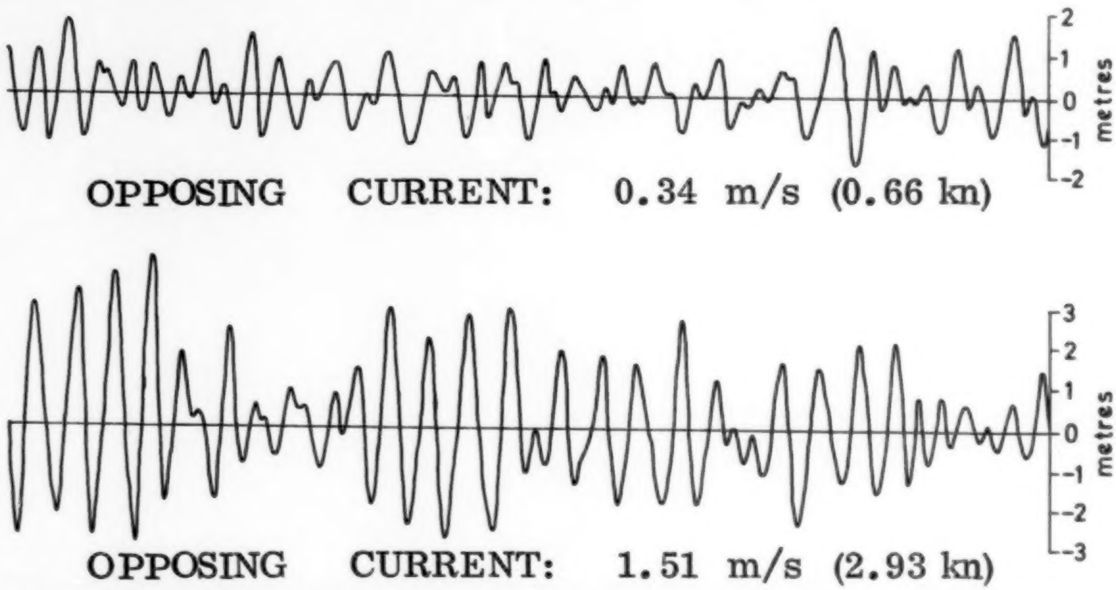

Figure 1.--Four minute-sections of wave records taken in and out of the main stream of the Agulhas Current by the RV MEIRING NAUDE on June 23, 1971, off Richards Bay.

vessel MEIRING NAUDE. The ship was drifting under similar conditions during both recordings, and additional analysis indicates that it was basically the same wave group that was being measured. The change in wave height is quite spectacular, and shows that the wave-current interaction merits serious study in any analysis of wave conditions on the east coast of South Africa. For, what ship's captain would not rather be sailing in the calmer seas of the upper recording of figure 1?

It is important to note that in this form of interaction, waves of different periods are amplified to different extents. Thus the height of a short-period wave (which also has a short wave length), increases proportionately more than the height of a wave with a longer period. Of course this can not go on indefinitely, and when the increase in height reaches a critical point breaking occurs. In a strong current region it may then occur that the shorter waves are amplified to the breaking point, while the longer waves pass through with just a change in height. Since the wave groups found in practice normally have a range of periods, a confused situation results with plenty of white water from the breaking of the shorter waves.

A factor which is probably more important to a ship's officer than merely the height of waves is the wave steepness. Figure 2 shows the wave length, L, and wave height, H, on an idealized wave profile. The wave steepness, S. can then be defined as

$$S = \frac{H}{1/2\ L}$$

This is seen to be an average steepness over the wave front as the height of the wave increases, or the length decreases, so the steepness increases. When the wave moves into a varying current region, both wave length and height change; in an opposing current it is "squeezed up", while in a following current

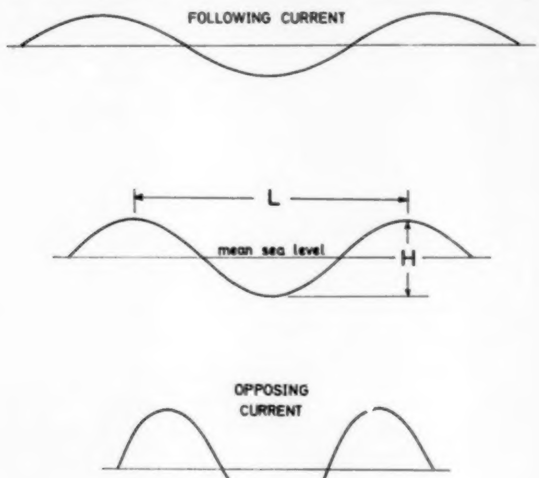

Figure 2.--An idealized wave profile showing the changes that occur in a following and an opposing current region.

it is "stretched out". However, it is important to note that this only happens while the current is varying, and under uniform conditions the waves propagate without change.

As far as a ship moving in a wave field is concerned, an apparent change in wave length also occurs depending on the speed of the ship. Thus, if the ship is moving against a wave group, the wave length apparently decreases due to the fact that the ship has itself steamed part of the distance between the consecutive wave crests. Hence the wave steepness, S, is increased, with the opposite happening if the ship and waves are moving in the same direction.

Figure 3 depicts the sort of changes that can be expected in wave steepness in a varying current region and relative to a moving ship. The left hand side shows the changes due to both following and opposing currents according to one theory (Longuet-Higgins and Stewart, 1961). The behavior of waves with three different periods is shown, the fractional change in wave steepness being with respect to the situation of zero current. This indicates that waves with periods less than about five seconds in still water can be expected to break if they propagate into a region where an opposing current greater than 2 m/s is flowing.

As with most theories, idealized conditions were assumed; however analysis of wave records such as those of figure 1 indicate that the magnitudes shown are correct. (Schumann, 1974). The change in wave steepness is seen to be much more gradual if the waves enter a following current.

The right-hand side of figure 3 shows the fractional change in wave steepness that can be expected for a ship moving in an opposing and following wave group. Again the change depends on the initial period of the waves, with short waves having the most pronounced effect.

It is seen that the two effects shown in figure 3 are of comparable magnitude in the situations likely to arise in practice. In those cases where a ship is steaming in a region where a current is flowing the effective change in wave steepness can be found by multiplying the two separate changes. This is so since the ship's speed changes the wave steepness already altered by the effect of the current.

Thus, if a ship is steaming into opposing 10 sec waves at 10 m/s (20 kn), the already existing wave steepness is increased by a factor of about 1.6. If in addition there is a 2 m/s current in the same direction as the ship (and therefore also opposing the waves), the wave steepness will be about twice that of waves outside the current.

Consequently, the total wave steepness increase relative to a stationary ship in still water will be 1.6 x 2 = 3.2. The figure shows that in order to decrease the effective wave steepness by a significant amount in this current, the ship would have to slow down considerably. Thus reducing speed to 5 m/s will only reduce the first factor to about 1.3 and the total steepness increase to 2.6. In these circumstances it may be preferable to avoid the current regime.

Application of these results to the open ocean should not be taken too literally. The sea surface is an extremely complex region involving the interaction of many different wave groups influenced by such parameters as currents, winds, temperatures, etc. Con-

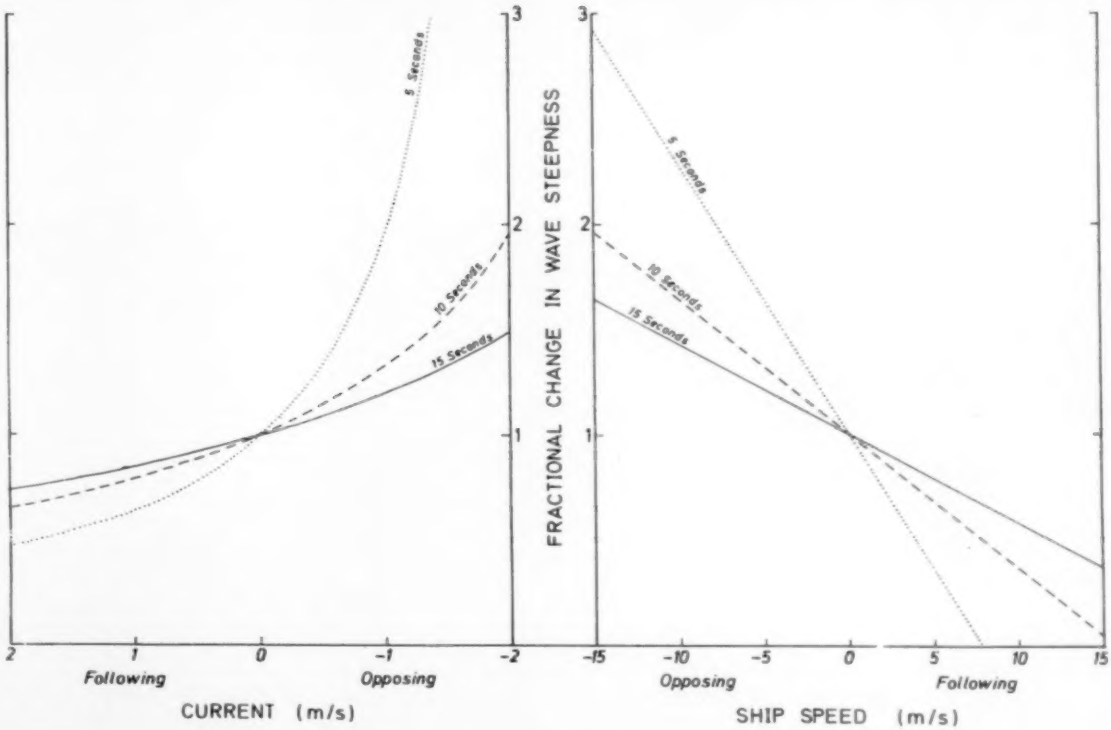

Figure 3.--Fractional change in wave steepness, S. The left side shows the actual change undergone by a wave moving from still water into the current regime, while the right side shows the apparent change caused by the motion of a ship in a wave field.

sequently, the simplified situations investigated should merely serve to give an indication of the types and magnitudes of the variations that can be expected. In any case, it is often difficult to estimate the periods of waves to any great degree of accuracy (e.g. fig. 1), the same applying to wave direction. This alone would jeopardize any dogmatic use of the results shown.

Nevertheless, the conclusions reached give reason for some rethinking on the best route to be followed and the action to be taken in rough weather, by a ship traveling in a southwesterly direction down the east coast. It is not necessarily the best policy to try to find the peak of the Agulhas Current in order to gain a "free" 2 m/s or so.

If southwesterly winds have generated large waves over the previous days, these will be amplified in the current to such an extent that the captain will have to slow the ship down by an amount greater than that gained from the current. Under the circumstances, it would probably have been better to have stayed out of the main current stream, from the point of view of speed, comfort and safety.

Additional Comment

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From Mr. Schumann's article it is apparent that the Agulhas Current, particularly the maximum speed of the current, is a place to avoid during southwest swell. Ship's officers can usually deduce swell direction from the daily weather charts, but the current is often only known from Sailing Directions and the Pilot Charts. Figure 4 has been drawn from accurate current measurements taken aboard this Institute's Research Vessel MEIRING NAUDE. It shows clearly that the expected current maximum falls approximately

on the 100 fathom line, as has been known from sailing-ship days. The dashed line in figure 4 gives the axis of the maximum speed. The main points of interest are the decided local speed maximum off East London and the hint of a northerly current past the zero isotach, some 90 mi. offshore.

This northerly current has been confirmed (Stavropoulos and Duncan 1974) with a satellite-tracked buoy. Northerly speeds some 180 mi offshore were about 50 cm/s.

Figures 5 and 6 were drawn from 17,000 ships' observations of swell in an attempt to identify the regional and seasonal variations expected from Mr. Schumann's predictions.

They do clearly show that the probability of high swell not only increases as winter comes, but increases very rapidly with latitude. Possibly the rapid decrease northwards results from both the decrease in speed of the Agulhas Current and the "masking" of southwest swell by the continent itself. Another factor is the decrease of southwesterly winds with decrease of latitude. The conditions shown here are averages, and cannot predict local and day-to-day conditions, but may prove useful.

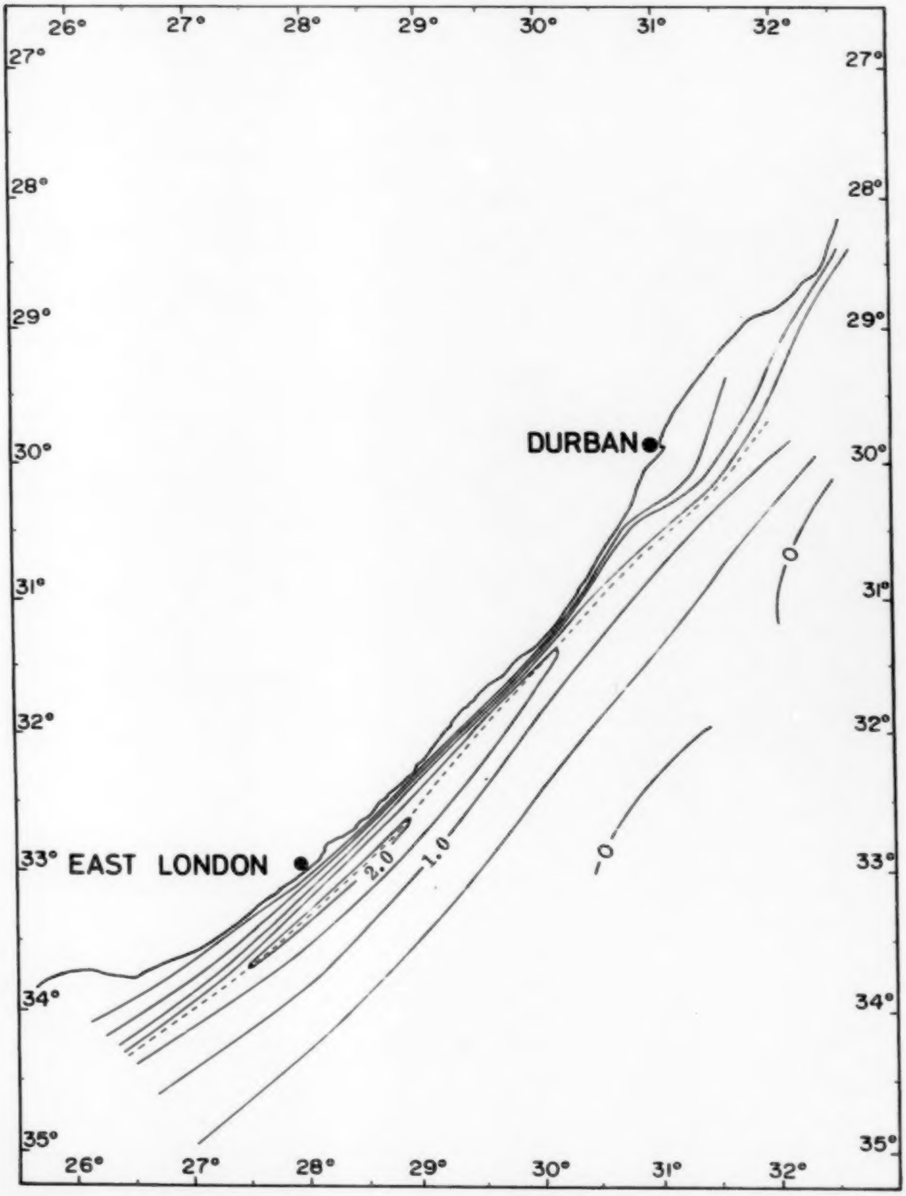

Figure 4.--Mean southerly current speed parallel to the coast in m/s.

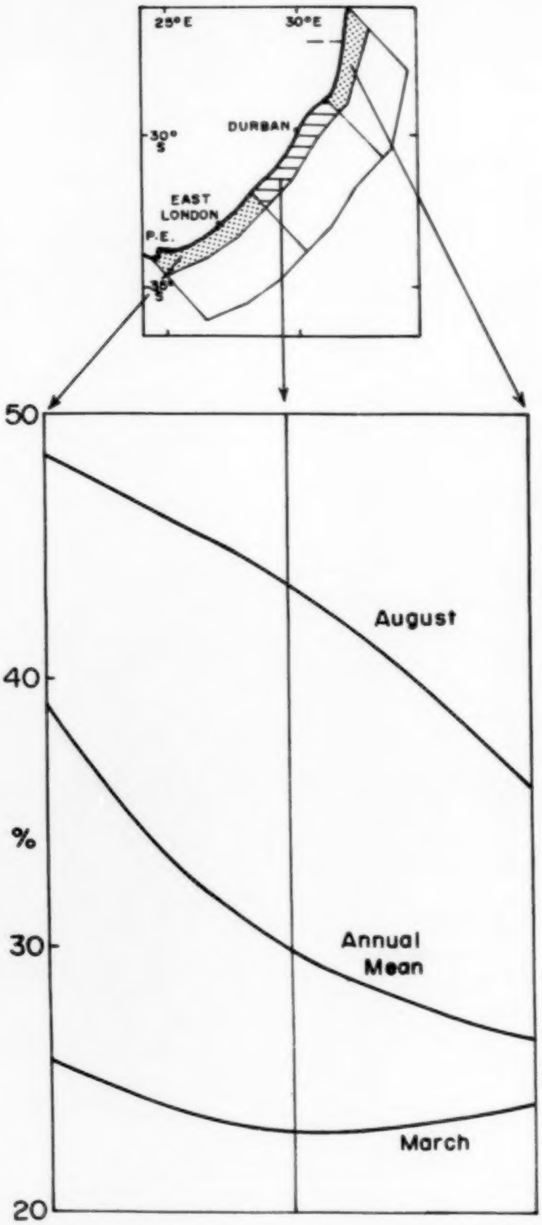

Figure 5. --Percent probability of swell higher than 4 meters.

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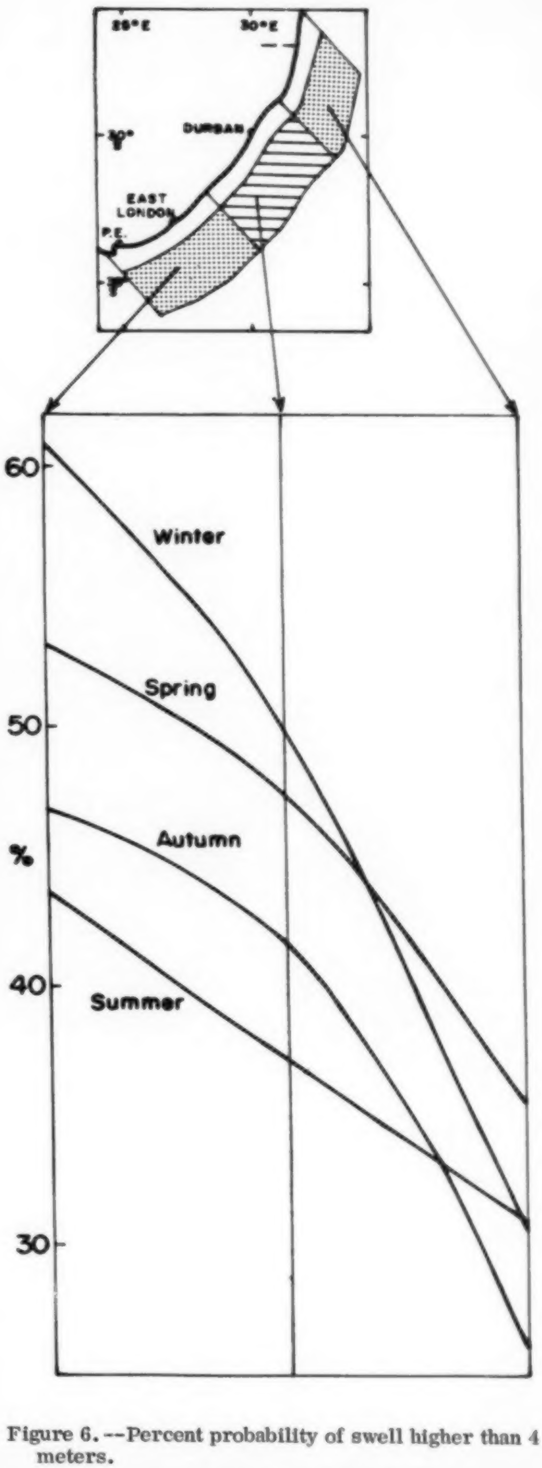

Figure 6. --Percent probability of swell higher than 4 meters.

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Mariners Weather Log

LOW WATER-STORM OF APRIL 3-4, 1975

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The importance of low water to the mariner, when the low water occurs in shallow navigation channels, was described in the May 1971 issue of the Mariners Weather Log. In April 1975, an extratropical storm caused this type of low water condition on Lake Erie, along the East Coast, and in Chesapeake Bay. The history of the storm and a description of the wind and waves were presented in the September 1975 Mariners Weather Log. This article is being written to present a description of the low water levels that resulted from this storm.

On April 2 at 1200, the storm was a weak low-pressure area centered just south of Springfield, Mo. It intensified rapidly as it moved northeastward through Illinois, Indiana, and Ohio. By 1200 on April 3, the storm had a central pressure of 982 mb and was centered near Buffalo, N. Y. The storm continued to intensify as it crossed New York and caused record low sea-level pressures for April at Hartford, Conn., Providence, R.I., Worcester, Mass., and Boston, Mass. (Wagner 1975). Lowest sea-level pressure was about 971 mb at Worcester, Mass. Figure 7 shows the 1200 sea-level pressure patterns for April 3 and 4.

This storm caused water-level anomalies both on Lake Erie and along the East Coast, including Chesapeake Bay. Lake Erie water levels were greatly disturbed on the 3d. Graphs of the water levels for Buffalo, N. Y. and Toledo, Ohio as recorded by NOAA's Lake Survey Center are shown in figure 8. The lake

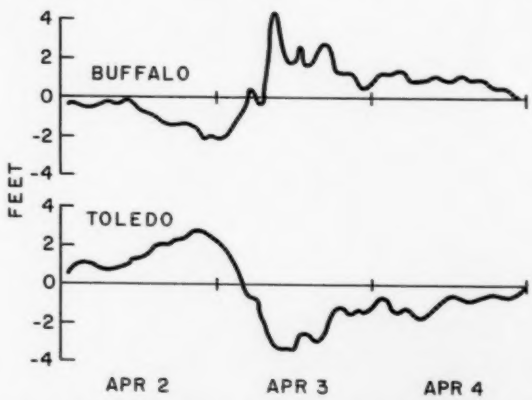

Figure 8.--Water level at Buffalo, N. Y., and Toledo, Ohio, for April 2-4, 1975. Height scale is in feet based on the normal water level. Days are separated at the midnight position EST (0500 GMT) on the horizontal scale.

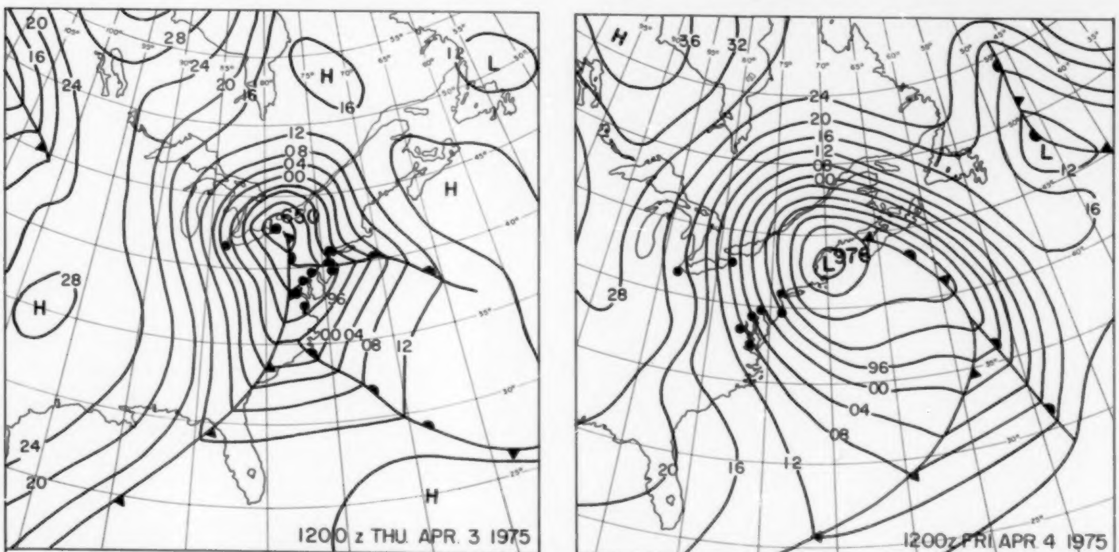

Figure 7.--Surface weather maps for 1200 GMT, April 3 and April 4, 1975.

level began to fall rapidly at Toledo about 2200 EST on the 2d. The level dropped about 6 ft in the following 12 hr. This was associated with a corresponding rise at the other end of Lake Erie as shown by the water-level graph for Buffalo, N. Y. Three-hourly wind observations made at the Weather Service Office in Toledo are given in table 1.

Table 1.--Wind velocities recorded at the Weather Service Office, Toledo, Ohio, April 2-3, 1975

		Direction	Speed
April 2,	1000 EST	070°	15 kn
	1300	070	13
	1600	070	14
	1900	060	14
	2200	030	12
April 3,	0100	020	11
	0400	310	16
	0700	300	22
	1000	300	20
	1300	300	21
	1600	300	20
	1900	290	15
	2200	290	15

Fastest mile - April 2 29 MPH from NE
April 3 36 MPH from NW

There are two ways to show water level variations along the coast. One way is to graph the actual water level which includes the variations due to the normal astronomical tide. The other way is to show the residual or departure of the actual tide from the normal astronomical tide. A 3-day length of tide record for New York at the Battery is shown in the upper part of figure 9. The low water condition of April 4 is quite evident even though the semi-diurnal tide is quite pronounced. By subtracting the astronomical tide from the observed tide for this 3-day record, one obtains the smoother curve of tidal departure from normal as shown in the lower portion of figure 9. This difference is an estimate of the meteorological effect on the sea level and is generally called the storm surge. The low water conditions of April 4 constitute a negative storm surge.

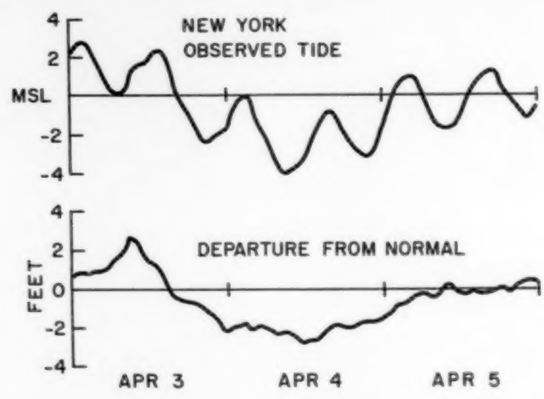

Figure 9.--Observed sea level and departure of sea level from normal astronomical tide at New York (Battery) for April 3-5, 1975. The height scale for the upper curve is in feet above or below mean sea level (MSL). The height scale for the lower curve is in feet above or below normal astronomical tide. Days are separated at the midnight position EST (0500 GMT) on the horizontal scale.

Graphs of the departure of normal tide are the more convenient type for considering meteorological effects on sea level. Such graphs are shown for the 4-day period, April 3-6, for New York, Atlantic City, Philadelphia, Baltimore, Washington, and Hampton Roads in figure 10. Three-hourly wind observations at nearby Weather Service Offices are shown in table 2. Early on April 3, the tide was above normal at these locations as the winds were from east to south ahead of the frontal system that was just inland. When the front reached the coast and moved offshore, the wind at these locations shifted and became quite strong, mainly from the west. This caused a rapid drop in the tide level as indicated in figure 10. Note the water level drops beginning around 1000 EST at New York. The water level fell from 2.7 ft above normal to 2.9 ft below normal by 0000 EST of April 4. This was a change of 5.6 ft in 13 hr. At New York the water stayed low through the 4th, returning to about normal level on the 5th.

Similar departures of the tide from normal occurred at the other locations represented in figure 10. The greatest departure occurred at Philadelphia. At some locations, especially in estuaries, residual oscillations of normal tidal periodicity often are present in graphs of tide departure from normal. Such oscillations are evident in the curves for Philadelphia and Washington. An explanation of such oscillations is that

Table 2.--Wind velocities recorded by the National Weather Service at several locations, April 3-6, 1975

April 1975	New York (JFK Internatl. Airport)		Atlantic City		Philadelphia		Baltimore		Washington		Norfolk	
	Deg.	kn	Deg.	kn	Deg.	kn	Deg.	kn	Deg.	kn	Deg.	kn
03/01E	090	14	180	16	090	8	170	8	170	9	180	14
04	110	12	180	15	180	10	150	13	170	9	200	16
07	140	24	180	26	160	20	170	15	190	17	210	15
10	160	26	200	19	300	18	299	26	300	19	280	23
13	270	18	290	23	290	18	270	30	310	25	290	31
16	270	34	300	30	290	32	270	30	310	33	300	30
19	280	34	290	34	290	30	290	25	310	18	320	27
22	290	33	300	30	290	32	290	25	310	22	290	20
04/01	280	33	300	26	290	27	280	24	300	25	300	21
04	290	29	300	28	300	20	290	20	280	20	310	24
07	300	30	300	25	310	20	[illegible]	25	320	24	310	24
10	300	33	290	28	320	30	290	27	310	25	310	28
13	300	31	300	27	310	22	290	26	310	26	310	24
16	320	28	320	28	330	20	300	28	320	27	310	21
19	310	31	320	22	320	20	310	27	320	23	310	22
22	310	29	320	23	320	23	300	15	330	21	320	18
05/01	310	21	310	17	320	27	300	21	320	15	330	14
04	320	23	320	22	320	18	310	18	310	20	340	14
07	320	23	310	18	320	19	290	15	320	15	330	14
10	330	20	310	21	310	21	310	19	330	22	340	18
13	320	22	330	27	320	20	310	23	320	24	350	20
16	310	28	350	25	340	20	310	23	310	23	320	21
19	320	24	340	20	340	20	310	18	330	16	330	19
22	320	20	320	19	320	13	310	16	330	17	340	16
06/01	320	22	310	16	310	17	310	15	320	14	320	15
04	320	17	330	16	320	19	290	12	320	12	330	17
07	320	19	310	14	320	15	290	11	330	11	350	20
10	340	18	320	21	320	16	310	15	330	20	340	20
13	320	22	340	15	310	14	320	15	340	23	310	17
16	320	24	330	15	340	18	310	20	320	22	320	15
19	320	20	340	16	340	20	300	20	320	18	010	13
22	330	17	340	20	340	20	290	12	330	20	350	12

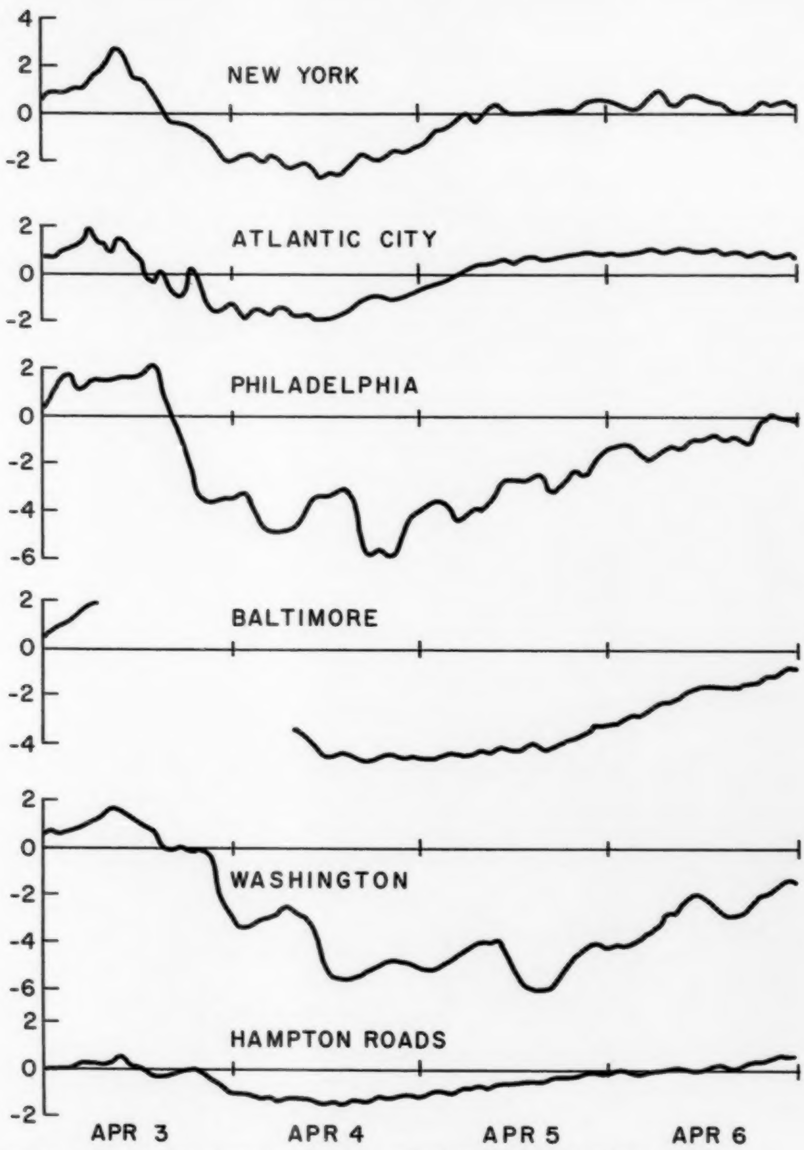

Figure 10. --Departure of sea level from normal astronomical tide at six locations for April 3-6, 1975. The height scale is in feet above or below normal astronomical tide. Days are separated at the midnight position EST (0500 GMT) on the horizontal scale.

the harmonic constants used for astronomical tide calculations for some estuarine locations are very effective for the calculation of high and low water but do not describe the astronomical tide between high and low water with the desired accuracy for determination of the departure from normal tide.

In conclusion, strong winds such as those of last April 3-4 can cause the sea level to fall much below normal. Such low water can constitute a threat to ships in shallow navigation channels. The Editor of Mariners Weather Log would appreciate hearing of any difficult navigation conditions caused by low water levels.

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THE WORLD OF TROPICAL CYCLONES
AUSTRALIA-SOUTH PACIFIC OCEAN

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"At 9 p.m. I noted the wind as 020° force 17, which indicates winds between 110 and 118 kn. This is not permitted in ship's weather reports, but only to shore stations with instruments. The glass was still falling, but that was no longer of much importance compared with the fact that the ship's head could no longer be kept into the wind; the bow was now about 45° off the wind, and we were heading north-northwest. I called for full speed and for the next half hour or so tried to get the bow back into the wind by frequent use of full rudder, but with less and less success as the wind and sea increased and increased. By now the ship's head was about west and as the wind had backed to about north we were broadside--on to the hurricane. This was most alarming and the ship was rolling so violently that the boats were straining their chocks, the deck cargo was breaking adrift, the gangways were being struck by heavy seas and the spray and rain were driving horizontally.... For the first time in my life I was in a ship which could not be brought up into the wind although I had been in six hurricanes before."

This is an excerpt from "Report on an Intense Hurricane" by Brett Hilder, captain of the 2,746-ton vessel TULAGI in the Australian Meteorological Magazine. The hurricane he describes raged in the eastern Coral Sea between the Loyalty Islands and the New Hebrides. This is an active tropical cyclone area within the Australia-South Pacific region.

In March 1970, satellites tracked a tropical storm past the Society Islands to about 140°W--this is about as far east as tropical cyclones range. Cyclone Gisele (April, 1967) generated hurricane force winds that whipped up 30-ft seas and sank the interisland ferry WAHINE in Wellington Harbor, New Zealand. Some storms retain their tropical characteristics that far south and others become extratropical or dissipate. In November 1967, Annie formed near 6°S, 165°E and moved across Bougainville Island in the Solomons. While uncommon, tropical cyclones do form north of 8°S. The westward extent of this area is marked at 100°E. Most storms that develop east of 100°E move toward Australia while those to the west often move toward Africa.

In an average season 14 tropical cyclones develop; five of these become hurricanes. Australians use the term "cyclone" to designate tropical storm strength or greater (winds $\geq$ 34 kn). They have three tropical cyclone centers (Darwin, Brisbane and Perth), each of which have their own set of names; another list of tropical cyclone names is used by New Caledonia. The tropical cyclone season generally runs from December through early April, although storms can form in any month. January, February, and March are the most active months as shown in tables 3 and 4. The beginning of the period of record in this table was selected on the basis of improved observation by satellite.

Table 3.--Frequency of tropical storms and hurricanes combined by months and years

Year	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Total
1960/61	0	1	4	5	5	0	0	0	15
1961/62	1	1	3	7	1	0	0	0	13
1962/63	1	2	6	5	4	3	4	2	27
1963/64	1	1	5	3	5	0	0	0	15
1964/65	0	0	3	2	4	1	0	0	10
1965/66	0	1	2	4	3	0	0	0	10
1966/67	1	1	4	1	5	1	0	0	13
1967/68	1	1	4	4	0	1	0	0	11
1968/69	0	3	2	6	1	2	0	0	14
1969/70	0	0	4	5	3	3	1	1	17
1970/71	1	3	2	5	2	0	0	0	13
Average	0.5	1.3	3.5	4.3	3.0	1.0	0.5	0.3	14.4

Table 4.--Frequency of tropical storms reaching hurricane intensity by months and years

Year	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Total
1960/61	0	1	1	4	1	0	7
1961/62	1	0	1	0	0	0	2
1962/63	0	1	1	2	1	1	6
1963/64	1	0	3	1	3	0	8
1964/65	0	0	3	1	3	0	7
1965/66	0	0	1	0	1	0	2
1966/67	0	0	4	0	2	0	6
1967/68	1	1	1	1	0	1	5
1968/69	0	1	0	3	1	0	5
1969/70	0	0	2	1	0	0	3
1970/71	1	1	2	1	0	0	5
Average	0.4	0.5	1.7	1.3	1.1	0.2	5.1

While the ratio of tropical cyclones reaching hurricane intensity is less than it is in the western North Pacific and North Atlantic, some of these storms do reach severe proportions. In February 1975, cyclone Trixie blasted Onslow, Australia with 133-kn wind gusts. A few months before, Darwin was ravaged by Tracy and her 117-kn gusts (fig. 11). Also along the west coast, a ship anchored near Roebourne, in April 1965, reported "a constant straight easterly 110 kn on ship's meter, barometer dropping like a stone." Australia's east coast seems less vulnerable particularly south of Brisbane. To the north a gust of 109 kn was recorded on Willis Island while one of 101 kn

Figure 11.--Effects of Tracy's winds are evident in the Capital of Australia's Northern Territory. (Courtesy of Australian Information Service, Barry Le Lievre).

blew at Bowen. In March 1975, cyclone Alison blew over New Caledonia, where sustained winds of 103 kn with gusts to 119 kn were reported at Baie Ugue. Farther east Bebe became one of the most severe storms in this region during October 1972. This out-of-season hurricane devastated the British Gilbert, Ellice and Fiji Islands. Winds exceeding 150 kn were reported (fig. 12).

Tropical cyclone activity varies within the region. Figures 13 through 15 show this variation along with seasonal differences and average paths. These tracks represent smoothed general movements. Individual storm movements are often much more complex. The figures were obtained from the U. S. Navy's Mariner's Worldwide Climatic Guide to Tropical Storms at Sea by Crutcher and Quayle.

For each 5° square there are two numbers on the charts. Constancy is the top value and is a measure of confidence in direction persistence; i.e., when the constancy is high (90 to 100), there is a high likelihood that a storm will continue in the same general direction for 12 hr. As the constancy decreases, confidence that a storm will remain on course decreases. Constancy, as a confidence measure, is directly related to the number of storms used to determine the figure. The bottom number is the average number of storms per year for the time period of that chart. Multiplication of this number by 10 or by 100 gives the approximate average number of storms per 10 yr or 100 yr, respectively.

Off the northwest coast of Australia, including the shipping lanes between the Cape of Good Hope and the Torres Strait, tropical cyclones are most active from January through March. Storms usually form off Indonesia and move southward to parallel the Australian west coast. Some recurve inland near the Northwest Cape particularly from mid-January to mid-February. Along the north coast and on routes to and from the Torres Strait, tropical cyclones are most likely in March. They often develop in the Arafura or Timor Seas or even in the Gulf of Carpentaria. They tend to move westward and then southward around or across western Australia.

In the Coral Sea region December activity is centered near the New Hebrides where southeastward moving storms that have formed around the Solomon Islands pass by on their way toward the Fiji Islands. In January activity increases and storms sometimes form in the Gulf of Carpentaria and move inland. Some make it southeastward across the Cape York

Peninsula and continue along the east coast of Australia. Later in the month and in early February, the east coast is less vulnerable as storms tend to move southward through the eastern Coral Sea; some reach New Zealand's shores. During mid- and late February there is a tendency for these storms to recurve southwestward and move ashore south of Brisbane. During March and April they are usually well offshore and again are a threat to New Zealand.

In the Pacific early season (November and December), activity is often concentrated between the Fiji and Solomon Islands. During January and February Pacific storms usually originate in the northern Coral Sea, near the Ellice Islands or the New Hebrides. They generally move east-southeastward or southeastward. The chance of an encounter is usually highest between the New Hebrides and New Caledonia. Except for some activity around Samoa, March storms are often confined to the eastern Coral Sea. April tropical cyclones tend to move from the northern Coral Sea to between New Caledonia and the New Hebrides southward through the western South Pacific.

At sea the mariner must rely on forecasts and his own experience to avoid tropical cyclones. A knowledge of the climatology should help him make the right decision. The March storm that caught the TULAGI was moving in a direction suggested by climatology. Captain Hilder's knowledge gained by experience helped him bring his ship to safety after a 16-hr ordeal.

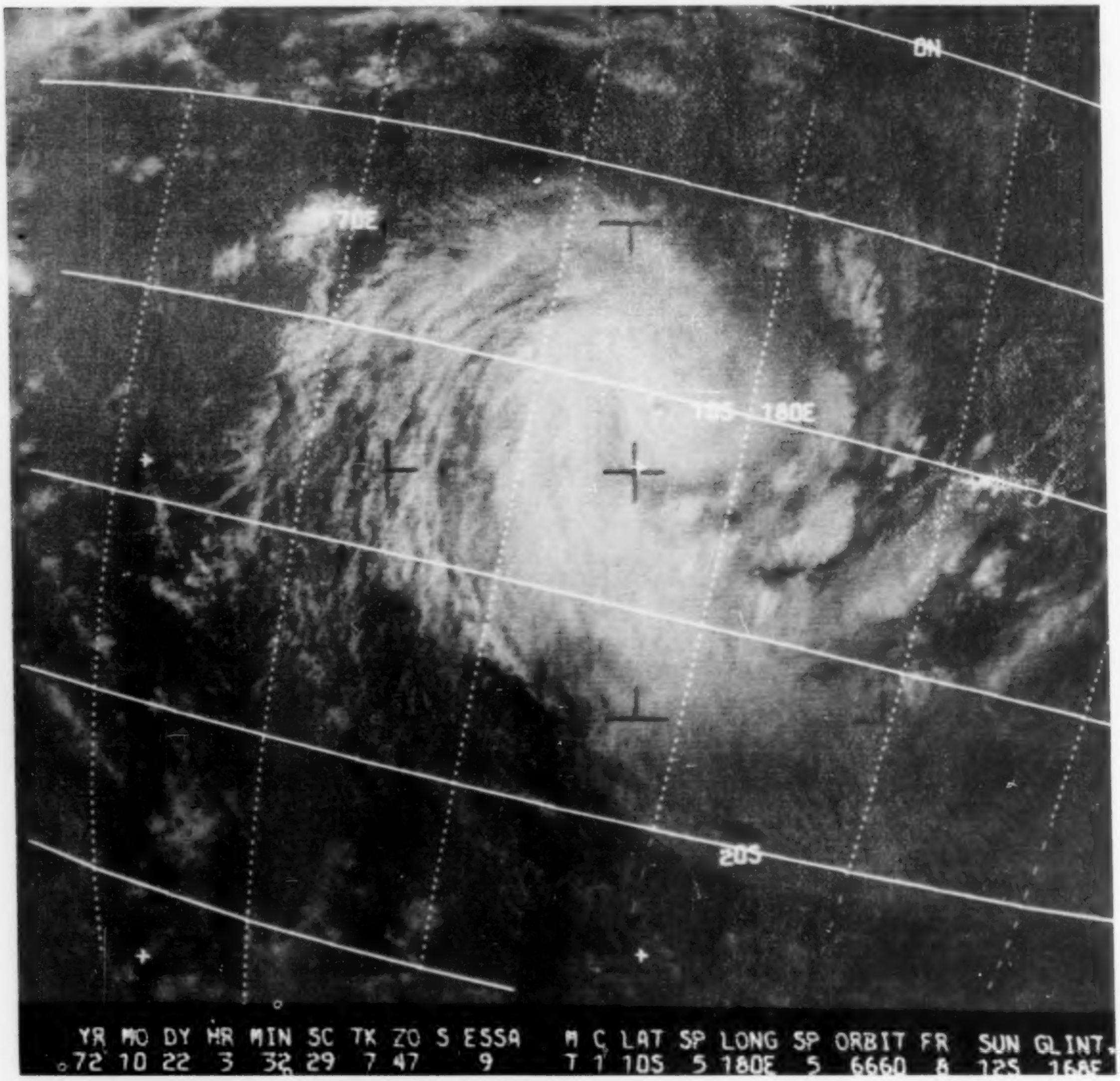

Figure 12.--Bebe is well developed with a conspicuous eye, when picked up by ESSA 9 on October 22, at 0332. This out-of-season hurricane caused severe damage to the Fiji Islands.

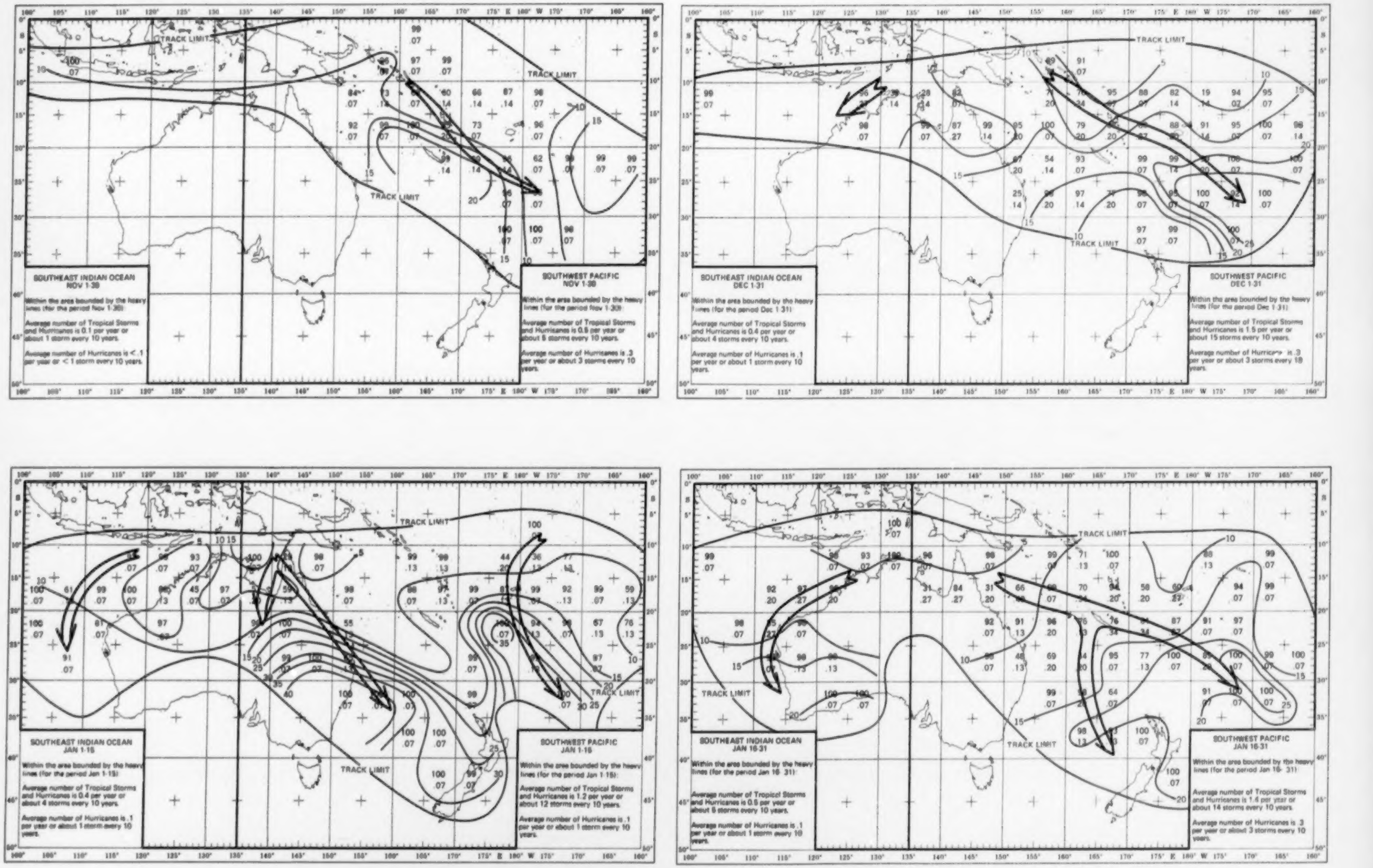

Figure 13.--Arrows show preferred storm track. Arrow width is proportional to the storm frequency within the ocean basin and the time period for each chart. Isolines show the average storm speed (scalar) in kn. The top value for each 5° square is the constancy. The bottom value is the average number of tropical storms and hurricanes per time period per 5° square.

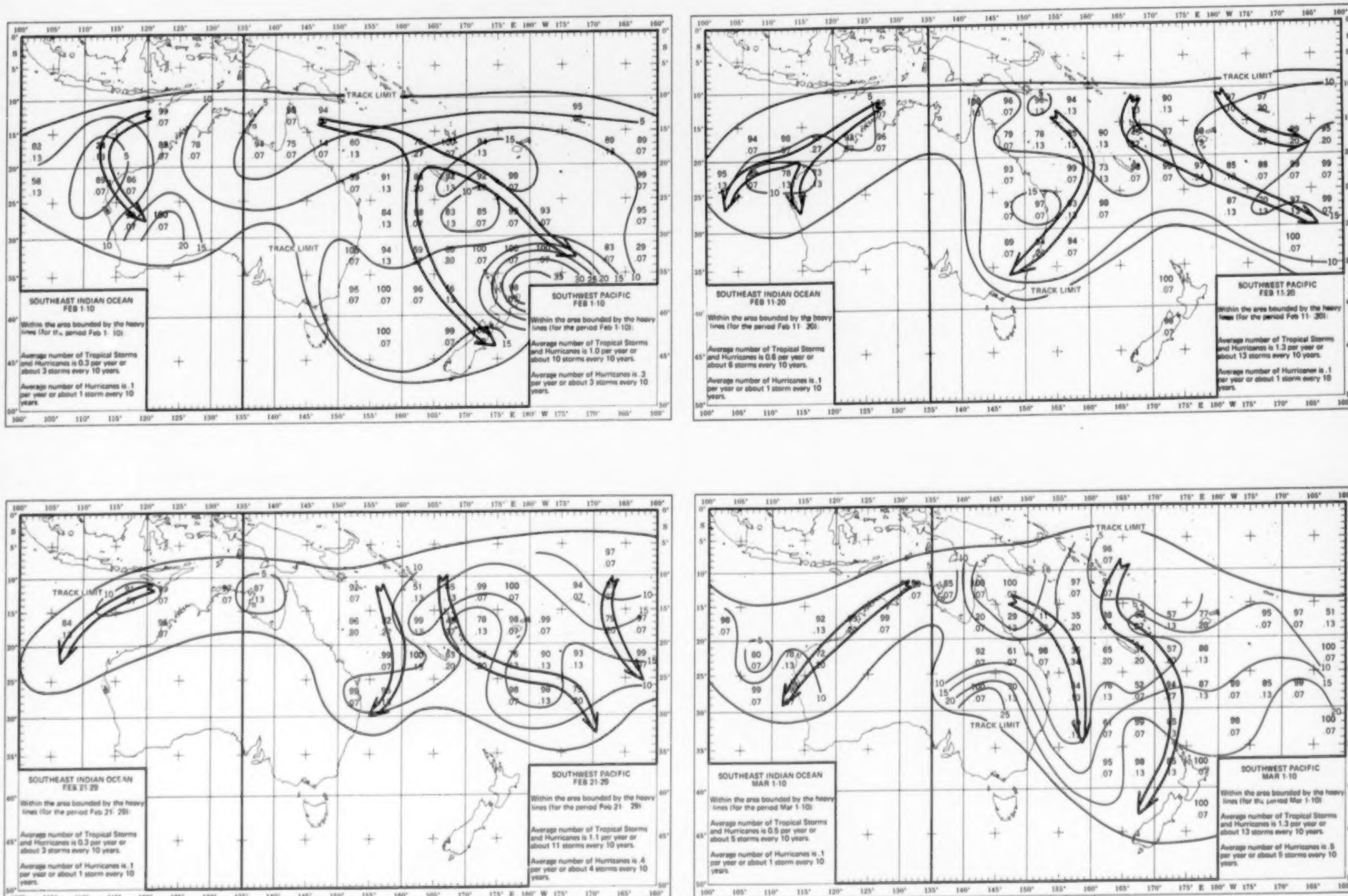

Figure 14.--Arrows show preferred storm track. Arrow width is proportional to the storm frequency within the ocean basin and the time period for each chart. Isolines show the average storm speed (scalar) in kn. The top value for each 5° square is the constancy. The bottom value is the average number of tropical storms and hurricanes per time period per 5° square.

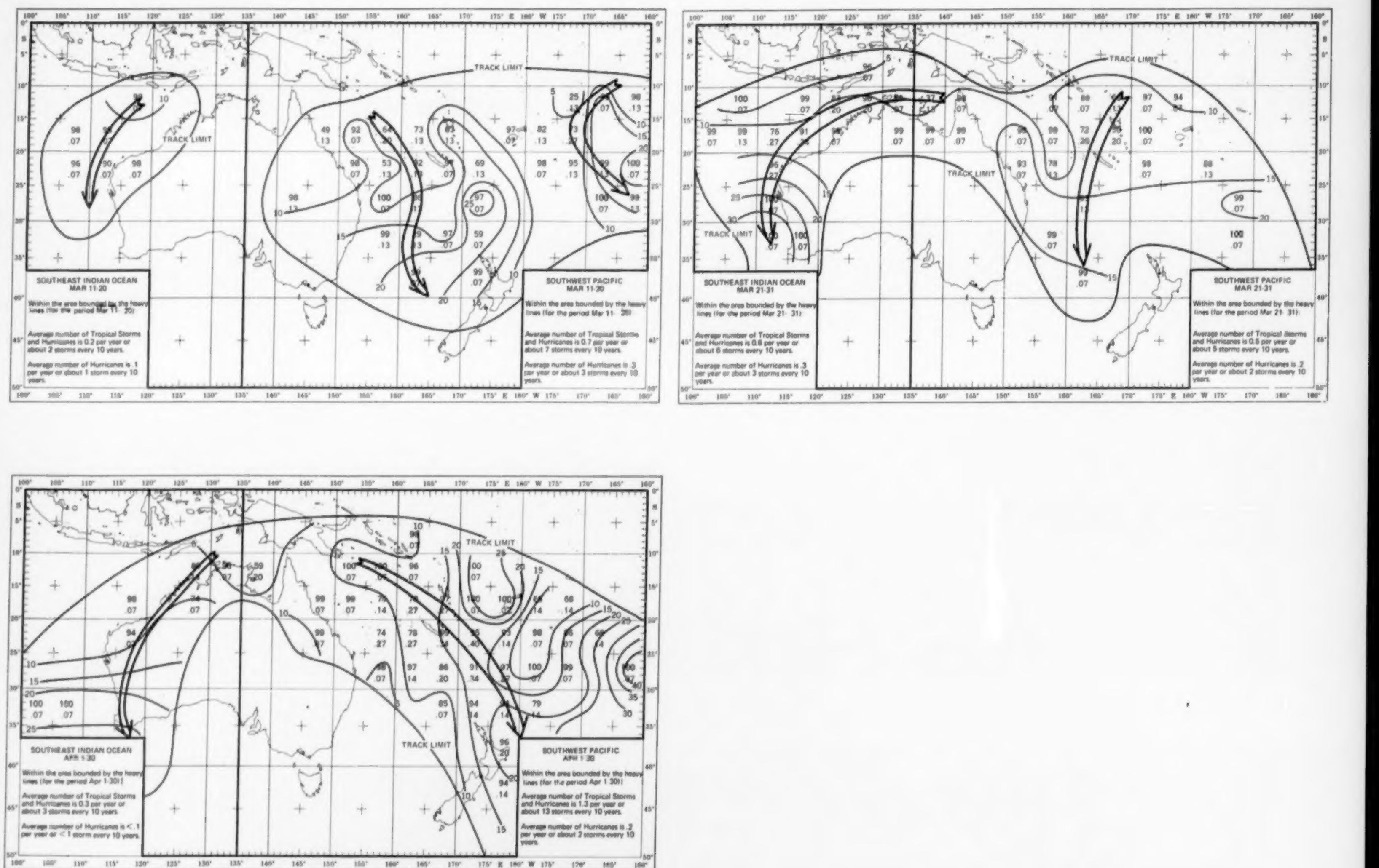

Figure 15.--Arrows show preferred storm track. Arrow width is proportional to the storm frequency within the ocean basin and the time period for each chart. Isolines show the average storm speed (scalar) in kn. The top value for each 5° square is the constancy. The bottom value is the average number of tropical storms and hurricanes per time period per 5° square.

Hints to the Observer

WIND CHILL--EQUIVALENT TEMPERATURES

All mariners are familiar with the difference in coldness one feels at a given temperature, depending on whether he is in the open wind on deck or sheltered.

The temperature of the air is not always a reliable indicator of how hot or cold a person will feel when outdoors. Other elements such as wind speed, relative humidity, and sunshine exert an influence. In addition, the type of clothing worn, as well as the state of health and metabolism of an individual, will have an influence. Generally, coldness is related to the loss of heat from exposed flesh; it can be assumed that coldness is proportional to the measured rate of heat loss from an object.

Heat loss occurs by means of radiation, conduction, and convection. Radiation and conduction are more constant than convection, therefore a formula and graph can be determined on wind and temperature alone. The accompanying table is a good approximation of the chill caused by convection--wind.

Conditions such as physical exertion, being in bright sunshine, heavy breathing of cold air, and health are not taken into consideration.

Table 5.--The table depicts equivalent temperatures for various combinations of wind and temperature. For example, a combination of 20°F and a 10-mph wind has the same cooling power as a temperature of 3°F

DRY BULB TEMPERATURE (°F)

WIND VELOCITY (MPH)	45	40	35	30	25	20	15	10	5	0	−5	−10	−15	−20	−25	−30	−35	−40	−45	
4	45	40	35	30	25	20	15	10	5	0	−5	−10	−15	−20	−25	−30	−35	−40	−45	4
5	43	37	32	27	22	16	11	6	0	−5	−10	−15	−21	−26	−31	−36	−42	−47	−52	5
10	34	28	22	16	10	3	−3	−9	−15	−22	−27	−34	−40	−46	−52	−58	−64	−71	−77	10
15	29	23	16	9	2	−5	−11	−18	−25	−31	−38	−45	−51	−58	−65	−72	−78	−85	−92	15
20	26	19	12	4	−3	−10	−17	−24	−31	−39	−46	−53	−60	−67	−74	−81	−88	−95	−103	20
25	23	16	8	1	−7	−15	−22	−29	−36	−44	−51	−59	−66	−74	−81	−88	−96	−103	−110	25
30	21	13	6	−2	−10	−18	−25	−33	−41	−49	−56	−64	−71	−79	−86	−93	−101	−109	−116	30
35	20	12	4	−4	−12	−20	−27	−35	−43	−52	−58	−67	−74	−82	−89	−97	−105	−113	−120	35
40	19	11	3	−5	−13	−21	−29	−37	−45	−53	−60	−69	−76	−84	−92	−100	−107	−115	−123	40
45	18	10	2	−6	−14	−22	−30	−38	−46	−54	−62	−70	−78	−85	−93	−102	−109	−117	−125	45

Tips to the Radio Officer

Warren D. Hight
National Weather Service, NOAA
Silver Spring, Md.

CORRECTIONS TO PUBLICATION, WORLDWIDE MARINE WEATHER BROADCASTS, 1973 Edition

Note: These same corrections will apply to the forthcoming edition of this publication.

Page 6--HALIFAX, NOVA SCOTIA (CFH): Amend area affected to read "North Atlantic waters west of 35°W."

Page 16--NORFOLK, VA. (NAM): Special Note. Effective Dec. 15, station NAM will be running a test for 30 to 90 days. Weather broadcast schedule during test is as follows: 0000, 0700, 1200, 1900.

Page 16--Details of marine weather broadcasts recently inaugurated by Coast Guard Radio Station NMH, Washington, D. C., appeared in the September 1975 "Tips." Delete the original entry and replace with the following:

Station: WASHINGTON, D. C. (NMH)

Area affected:[1]

(a) North Atlantic north of 32°N and west of 35°W.
(b) North Atlantic south of 32°N and west of 35°W.
(c) Offshore waters: north of 41°N and west of 60°W (New England waters).
(d) Offshore waters: 32°N - 41°N and west of 65°W (West Central North Atlantic Waters).
(e) Offshore waters south of 32°N and west of 65°W (Southwest North Atlantic).
(f) Gulf of Mexico.
(g) Caribbean Sea.

Time of broadcast	Frequencies (kHz) and mode	Content
0400	4393.4 (A3J) 6521.8 (A3J) 8760.8 (A3J)	Synopsis and forecast, areas c and d.
0530	do.	Synopsis and forecast, areas a and b.
1000	do.	Synopsis and forecast, areas c, d, e, f, and g.
1130,2330	6521.8 (A3J) 8760.8 (A3J) 13144 (A3J)	Synopsis and forecast, area a.
1600,2200	do.	Synopsis and forecast, areas c, d, e, f, and g. Gulf Stream analysis in plain language.
1730	8760.8 (A3J) 13144 (A3J) 17290 (A3J)	Synopsis and forecast, areas a and b.

[1]See figure 3, page 11.

Page 17--NORFOLK, VA. (NMN): Amend description of area affected to read: "(a) Offshore waters: 32°N - 41°N, west of 65°W. (b) Coastal waters: Cape May, N. J., to Savannah, Ga." Revise the description of the 0120 and 1620 GMT broadcast contents to read: "Forecasts and warnings for area a; warnings for area b. Gulf Stream analysis in plain language." Revise description of the 0500, 1100, 1700, and 2300 broadcast contents to read: "Forecasts and warnings for areas a and b."

Page 20--MIAMI, FLA. (NMA): Details of the revised broadcast schedule were published in the November 1975 "Tips". Add to the contents of the 0100 and 1600 GMT broadcast on 440 kHz (A1): "Gulf Stream analysis in plain language."

Page 56--SAN FRANCISCO (PT. REYES), CALIF. (KMI): Delete all the listed frequencies and enter the following: "4371, 4399.8, 8738.4, 8735.2, 13161.5, 13151, 17307.5, 17304, 22671, 22667.5 kHz."

CORRECTIONS TO PUBLICATION, RADIO STATIONS ACCEPTING SHIPS' WEATHER OBSERVATIONS

Page 5--Baltimore, Md. (WMH): Amend list of frequencies to read: "428, 8686, 12952.9 (1100-2400)."
Chatham, Mass. (WCC): Amend list of frequencies to read: "436, 4331, 6376, 8586, 8630, 12925.5, 13033.5, 16972.5, 16933.2, 22518."
Port Arthur, Tex. (WPA): Amend list of frequencies to read: "416, 4322 (0000-1200), 6435.5 (0000-1200), 8550, 12839.5 (1200-2400)."
Tuckerton, N. J. (WSC): Delete the frequency "6502 kHz."

Page 10--Cadiz, Spain (EAC): According to the radio officer of MV BAKAR (LFSU), the station would not accept the ship's weather message.

Page 11--Napoli, Italy (IQH): Amend list of frequencies to read: "435, 444."

ACKNOWLEDGEMENT OF CORRESPONDENCE

Thanks to Patrick Nolan, RO, SHIRLEY LYKES, and Alan Van Sickle, REO, AMERICAN ASTRONAUT, for recent letters containing information relative to the marine weather program.

Hurricane Alley

Dick DeAngelis
Environmental Data Service, NOAA
Washington, D. C.

Southern hemisphere tropical cyclone activity is generally light during September and October, and this year was no different. No storms developed. In the North Indian Ocean, October and November are considered the heart of the season, while September can be active. This year there were no September storms, but two, including a severe hurricane, did develop in October (fig. 16).

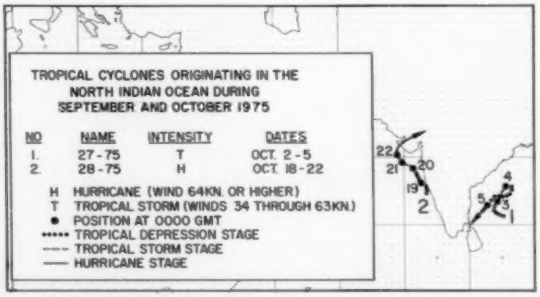

Figure 16.--North Indian Ocean tropical cyclones, September and October 1975.

NORTH INDIAN OCEAN

Early in October, a weak depression developed about 300 mi east-northeast of the northern tip of Ceylon, a favorable area at this time of the year. The system tracked slowly northward and quickly became a tropical storm. Winds near the center climbed to about 40 kn on October 3. However, by October 4, the storm was downgraded to a tropical depression, and it looped back toward the southwest.

On October 18, a depression was sighted off the west coast of India near 15°N. Climatology dictates an initial northwesterly movement with the storm either turning westward across the Arabian Sea or recurving northeastward toward the Saurashtra Peninsula. This system chose the latter course. On October 20, it reached tropical storm strength off Bombay, and by October 21 it was a full-fledged hurricane. It continued to intensify as it recurved. Before making landfall (fig. 17), just south of the Gulf of Kutch, winds near the center reached 85 kn.

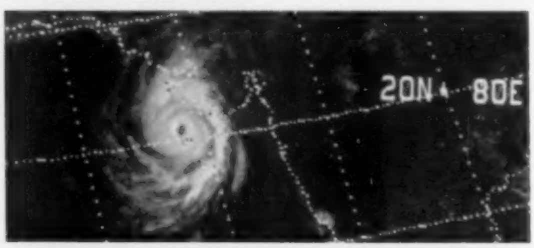

Figure 17.--Tropical cyclone 28-75 reaches its peak as it approaches India's Saurashtra Peninsula on the 22d.

The following report is based on the tropical cyclone summary kindly provided by the National Meteorological Service of Reunion and translated by Vicki Jones of NOAA.

SOUTHWEST INDIAN OCEAN, 1973-74

Five tropical storms and two hurricanes were spawned in the southwest Indian Ocean in the 1973-74 season. This is less than the average of seven tropical storms and four hurricanes. The usually besieged Mascareigne zone, which comprises the islands of Reunion, Maurice, Rodrigues, Saint-Brandon, and Tromelin, was remarkably tropical cyclone free. This was due in part to the lack of storms during the mid-season. Early and late season storms often remain north of these islands. Dalida was the season's most potent storm. Winds near her center climbed past the 100-kn mark (table 6).

Table 6.--Summary of southwest Indian Ocean tropical cyclone season, 1973-74

Number	Name	Intensity*	Dates	Maximum wind (kn)	Lowest pressure (mb)
1	Alice	T	September 14-24	40-45+	1000
2	Bernadette	H	October 16-28	80	985
3	Christiane	T	December 13-21	40	995
4	Dalida	H	Dec. 24 - Jan. 6	108	965
5	Esmeralda	T	Dec. 30 - Jan. 6	40	995
6	Ghislaine	T	Feb. 22 - March 4	80+	985
7	Honorine	T	April 12-23	55	998

*H - hurricane; T - tropical storm.
+ Gusts

Both Alice (September) and Bernadette (October) were considered preseason storms. Both moved on a general westerly path (fig. 18). Alice was a tropical

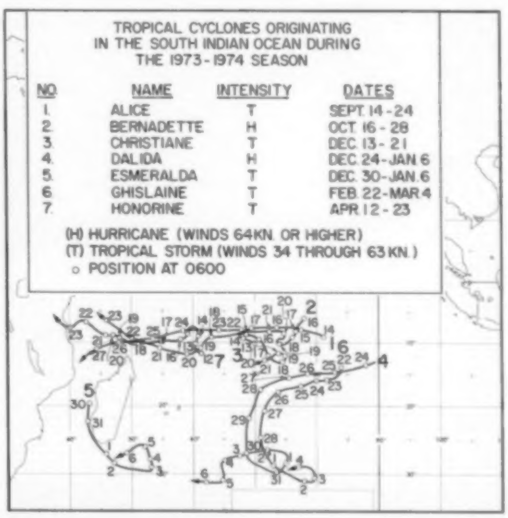

Figure 18.--Tropical cyclones of the South Indian Ocean during the 1973-74 season.

storm that brought only rain to the north coast of Madagascar and 30-kn gusts to Diego-Suarez. Bernadette was more intense. She reached hurricane strength for a brief period on October 26, when winds rose to 80 kn around a 985-mb pressure center. Winds on Diego-Suarez gusted to 40 kn, and a ship off Cape d'Ambre, Madagascar, registered 75-kn winds.

Three tropical cyclones developed in December. Christiane was a weak tropical storm that flared up briefly in the middle of the month just southwest of Diego-Garcia. Then came Dalida. On December 27, she was headed for the Mascareignes, but the following day she recurved toward the south. Dalida reached her peak during this period, when winds climbed to 108 kn around a 965-mb central pressure. Esmeralda formed late in the month in the Mozambique Channel. She skimmed the east and south coasts of Madagascar bringing winds up to 40 kn. After moving eastward, she looped back during January 3 through 5. During this period she caused heavy rains on Reunion some 500 mi to the northeast. Up to 16 in of rain fell, and 24-hr amounts of 8 to 9 in were common. On December 4, Dalida and Esmeralda were within 600 mi of each other.

There was a long dry spell with just a weak January depression before Ghislaine formed in late February. Like Dalida she remained well east of the Mascareignes. She recurved before she could reach hurricane intensity. Honorine was a late season storm that moved westward, remaining north of Madagascar. She brought moderate rain to the northern part of that island and also to Glorieuses and the Comoro Islands, where winds reached gale force in gusts. Honorine was at her strongest from April 17 to 20, when winds of 50 to 55 kn blew around a 998-mb center.

On the Editor's Desk

WEATHER FORECASTS ON SINGLE SIDEBAND RADIO

Mariners in the Gulf of Mexico, Caribbean Sea, and off the east coast of the United States can now receive additional high seas and offshore weather forecasts over single sideband radio.

The forecasts, prepared by the National Weather Service, are broadcast by the U. S. Coast Guard from its Washington, D. C., radio station. Broadcasts are made on an average of four times a day, lasting for 5 to 10 min. For details on these broadcasts, see "Tips to the Radio Officer" on page 16.

The broadcasts were started by the Coast Guard after favorable boater reaction to similar, special, weather broadcasts during the Annapolis, Md.-Newport, R. I. Yacht Race and the Newport Trans-Atlantic Race.

GREENWICH OBSERVING 300TH BIRTHDAY

The Royal Greenwich Observatory is celebrating its 300th anniversary. To most people, Greenwich means time. GMT--Greenwich Mean Time--is the standard by which all the world's clocks are set.

To others it means the Greenwich Prime Meridian, an imaginary line of longitude 0° which slices through Greenwich's old buildings and is the base for the world's maps.

These are relatively new achievements not adopted worldwide until 1884. They grew from the tasks Greenwich always has done--measuring time and measuring the stars.

The Greenwich Observatory today means two places--a pink brick castle at Herstmonceux and the venerable buildings atop Greenwich Hill in a London suburb.

Birthday exhibits and open houses at both places make the point that Greenwich was established originally to keep people from getting lost.

Navigation at sea out of sight of land was difficult. Three things were necessary--accurate predictions of the motions of heavenly bodies, accurate measurement of time, and an accurate means of measuring the positions of heavenly bodies from a ship at sea.

Greenwich was founded to produce all three. King Charles II's 1675 charter ordered it "to find out the so much desired longitude at sea, for the perfecting of the art of navigation."

Sir Christopher Wren, architect of London churches, designed the observatory buildings. King Charles, neglected to allocate his project enough money, so the buildings were paid for by the sale of spoiled Navy gunpowder.

Wren's buildings still crown the steep hill at Greenwich, 10 km west of central London. They are museums now, ghostly and haunted with instruments which outlived their time.

One of these instruments, a great black telescope in a curious 18th century building, precisely established the prime meridian, base line not only for maps but for the world's time zone system based on GMT. An international conference in Washington adopted both in 1884.

Across the courtyard of this "meridian building" slices a thin brass line exactly at longitude 0°. Visitors today love to straddle it, standing with one foot in each hemisphere.

Greenwich's first royal astronomer, John Flamsteed, was happy if he could measure time to an accuracy of a few minutes either way. Today's atomic clocks at Herstmonceux are accurate to one ten-thousandth of a millionth of a second.

Flamsteed's telescopes studied the moon, Earth's closest neighbor. Today's Greenwich astronomers peer unfathomable distances to the fringes of the universe.

Gradually London's sprawl created too much pollution and too many city lights for accurate observation from Greenwich, so the observatory moved 96 km south of London to the clearer countryside of Sussex.

It is now a space-age laboratory headquartered in a 500-yr old castle, romantic and turreted inside its moat. A dozen observatory buildings are scattered

in its vast rolling park.

GMT is still measured here, its time signals from Herstmonceux broadcast around the world. The observatory's six atomic clocks are continuously matched against each other for accuracy.

The biggest of the nine telescope domes dotting Herstmonceux's 368 acres holds Western Europe's largest telescope. It is named for Sir Isaac Newton, discoverer of the laws of gravity, who made the first compact telescope in 1671.

A tiny model of his first telescope sits today in a glass case under the new Isaac Newton telescope's vast dome. On the case someone has put a sign saying, "In case main telescope fails, break glass."

GULF STREAM WALL BULLETIN BROADCAST

United States Coast Guard Coast Radio Stations at Portsmouth, Va. (NMN), Miami, Fla. (NMA), and Washington, D. C. (NMH), started broadcasting Gulf Stream Analyses issued by the National Weather Service. This new analysis consists of a line representing the location of the west wall of the Gulf Stream from latitude 27°N off the Florida coast to the position at which the Gulf Stream crosses longitude 70°W. The line will be extended further to the east when data are available to do so.

The Gulf Stream information will be given in plain language immediately following the Marine Weather. The following is a sample message:

> "Gulf Stream Location. The line described by the following sequence of points represents the west wall of the Gulf Stream. 27.0N/79.9W 28.1N/80.1W 29.9N/80.2W 31.0N/79.7W 31.8N/78.0W 33.0N/76.8W 34.0N/76.0W 35.7N/74.3W 36.7N/72.5W 37.7N/72.1W 38.0N/71.2W 37.8N/70.0W. The maximum current of the Gulf Stream lies 20 to 40 km seaward of this line."

Portsmouth will broadcast (cw) at 0120 and 1620 on 448 kHz; Miami (cw) at 0100 and 1600 on 440 kHz; and Washington (voice-single sideband) at 1600 and 2200 on 6521.8, 8760.8 and 13144.0 kHz.

MARINE DATA ACQUISITION CONFERENCE

The Data Systems Division, Office of Technical Services, hosted a Marine Data Acquisition Conference at Weather Service Headquarters on October 21-23, 1975. Presentations were given by representatives of five NOAA components: the Oceanographic Services Office, Office of Sea Grant, National Weather Service, National Environmental Satellite Service, and Environmental Data Service; three Department of Defense units: the Air Force Weather Service, Naval Weather Service, and Defense Mapping Agency; and by the U. S. Coast Guard and Canadian Atmospheric Environment Service. The conference addressed (1) the growing importance and expected increase in marine programs; (2) the ongoing marine programs of the Atmospheric Environment Service of Canada, Department of Defense, Department of Transportation, and National Oceanic and Atmospheric Administration; (3) the problems confronting marine programs; and (4) how marine programs can be improved.

BRITISH METEOROLOGICAL LOGBOOKS

The Port Meteorological Office in New York stocks a supply of British Meteorological Forms for British ships. They are available to British ships on request. The Port Meteorological Office can be contacted by telephone at 212-971-5569.

VETERAN PMO RETIRED

The following was submitted by Julius L. Soileau, the Port Meteorological Officer at Houston, Texas. He has received numerous inquiries concerning Millard E. McKinnie, "Mac," a former Port Meteorological Officer at Houston.

"Millard E. McKinnie, 'Mac,' the Port Meteorological Officer at Houston for 22 yr retired June 30, 1975, with 34 yr of service. Ship's officers still frequently inquire about him even though his duties for the past 5 yr were other than marine. He began his Weather Service career in 1941 at Omaha, Neb. In 1944, he had a shipboard weather assignment out of Boston. In 1947 he arrived in Houston as the marine meteorologist. On retirement he moved north to Moorhead, Minn."

NEBRASKA MAN HONORED FOR 70 YR OF WEATHER WATCHING

An 89-yr old retired farmer in Nebraska, who recently completed 70 yr of recording official weather observations, has had a new National Weather Service award named after him.

The Edward H. Stoll Award becomes the most recent of the Weather Service recognition certificates given to unpaid observers reporting weather data. More than 13,000 volunteers collect and record almost 5 million observations a year.

Other awards honor Thomas Jefferson and the Rev. John Campanius Holm, early American weather pioneers, but the Stoll Award is the first named for a contemporary observer.

Edward H. Stoll of Elwood, Neb., began his observations in 1905--before anyone in the present-day weather service was born--and has recorded more than 25,500 individual daily observations. Now retired from active farming, he lives on the same farm to which his parents brought him when he was only 1-1/2 yr old.

In 1960 Stoll won the Holm Award; in 1970 he was named outstanding citizen of the State of Nebraska; and in 1973 he received the Jefferson Award. Stoll is still active and is a gold mine of information about weather events he has observed.

NOAA DEDICATES CLIMATE MONITORING OBSERVATORY AT AMERICAN SAMOA

A new observatory to keep an eye on atmospheric gases and particles that may affect the Earth's climate was dedicated November 27, 1975, in American Samoa. It is the fourth in a developing network of observatories around the world to measure atmospheric constituents that may occur in extremely low concentrations but are likely to have a significant influence on future climate. The network is part of NOAA's Geophysical Monitoring for Climatic Change (GMCC) program.

Measurements from Samoa and the other NOAA

observatories in Antarctica, Hawaii, and Alaska, can be used to determine long-term changes in the concentrations of carbon dioxide, ozone, fluorocarbons, and carbon tetrachloride near the Earth's surface and detect changes in the protective ozone layer of the stratosphere. The measurements could help answer the growing number of questions about mankind's contribution to these rare gases and their effect on climate. The program is managed by the Air Resources Laboratories of NOAA's Environmental Research Laboratories.

The formal dedication was held at the newly completed observatory building on Cape Matatula, Tutuila Island. Scientists from the University of Rhode Island, with the support of the National Science Foundation, will be working at the Samoa GMCC Observatory in an 18-mo cooperative effort to measure marine aerosols. The observatory is on land leased from Chief Iuli Togi, which required signing of a treaty in 1974.

At the new Samoa observatory, a three-man team will monitor aerosols (small, airborne particles) of various sizes, chemical constituents of precipitation, and conventional weather elements of climate (temperature, humidity, precipitation, barometric pressure, surface winds), in addition to low-concentration gases that are thought to influence climate. The observers also will measure three man-made gases: carbon tetrachloride and fluorocarbons 11 and 12. (Studies are underway at a number of institutions to determine whether fluorocarbons, used as propellants in aerosol cans and in refrigeration, may affect the stratospheric ozone shield, which protects life on the Earth's surface from potentially hazardous ultraviolent radiation.)

The NOAA global monitoring program began in 1970 when the newly formed Geophysical Monitoring for Climatic Change program set out to establish a small, widely separated network of observatories equipped to precisely measure the selected key constituents at locations far from the centers of civilization.

Two observatories are older than the program itself. These, at Mauna Loa, Hawaii and at the South Pole, were initially established in the late 1950's for the International Geophysical Year. A third observatory at Point Barrow, the northernmost extremity of Alaska, was added to the network in 1973.

The scientists also analyze the data for changes and long-term trends in concentrations of those rare gases and aerosols that may modify solar radiation and radiation from Earth, thereby altering climate. They have developed a numerical model that incorporates both sources and sinks for carbon dioxide and can be used for predicting future carbon dioxide concentrations. Carbon dioxide measurements from the four GMCC observatories are being used to verify the accuracy of the model.

Measurements recorded at the observatories are sent to GMCC headquarters in Boulder, Colo. There, scientists process the data before archiving them at the World Data Center in Asheville, N. C. Administered by NOAA's National Climatic Center, the data center provides for international data exchange.

So far, these four observatories are the only complete, operational baseline stations in the world making such measurements. But other nations are planning similar observatories leading towards a data collection program international in scope. These observatories will provide raw data that scientists around the world can combine with data on other climatic influences (such as the oceans) and climatic indicators (such as temperature and wind) to help understand the causes of climate. Such understanding will eventually serve as the basis for prediction of climate.

VHF-FM COMMUNICATIONS SITE OPERATIONAL

A Coast Guard VHF-FM remote communications site atop Cahto Peak in Mendocino County became operational on October 29, 1975, completing a system which provides total coverage for U. S. coastal waters.

The site, which stands atop the 4,233-ft mountain, is designed to provide VHF-FM communications for marine distress and rescue operations from Cape Mendocino to Point Arena. It is remotely operated by Coast Guard personnel at Humboldt Bay.

The Federal Communications Commission (FCC) designated VHF-FM channel 16 (156.8 MHz) as the distress frequency in 1968.

Cahto Peak is the last major site in the Coast Guard program to provide distress coverage on channel 16 within 20 mi of all continental coasts, major rivers and bays within the U. S.

This site will broadcast important notices to mariners and weather forecasts at 1545 and 2315 on channel 22 (157.1 MHz). Wind warnings will be broadcast upon receipt from the National Weather Service.

The establishment of this site required the coordination and cooperation of the Bureau of Land Management, the State of California and the Federal Communications Commission.

The increased use of channel 16 by the boating public has enhanced the capabilities of the Coast Guard's boating safety efforts.

UPWELLING ALONG NORTHERN CALIFORNIA COAST

This infrared image (fig. 19) was taken from the NOAA-3 polar orbiting satellite on August 1, 1975, at 0416. It was recorded at the Satellite Field Service Station (SFSS) in Redwood City, Calif., from the Very High Resolution Radiometer (VHRR) aboard the satellite. The resolution of the VHRR is approximately 1 km.

This picture shows an almost cloud free area of the Pacific Ocean along the California coast from south of Monterey Bay to near the Oregon border. Lighter grey shades indicate cooler sea surface temperatures; darker grey shades indicate warmer temperatures.

The image depicts upwelling along the California coast. Upwelling results from the persistent northerly winds caused by the high pressure system that is normally located in the eastern North Pacific during the summer months. Northerly winds along the coast cause cold water from below to upwell and spread out along the surface. When these cooler waters interact with warmer offshore waters, complex swirls and eddies of the type shown in this image are formed. Temperature sensitive fish such as salmon and albacore tend to concentrate along the resulting thermal boundaries where the upwelling brings cold, nutrient laden waters from the depths of the ocean up to the surface.

The positions of these thermal boundaries as seen through NOAA-3 and NOAA-4 satellite imagery are presently being provided to the fishermen off California's north coast.

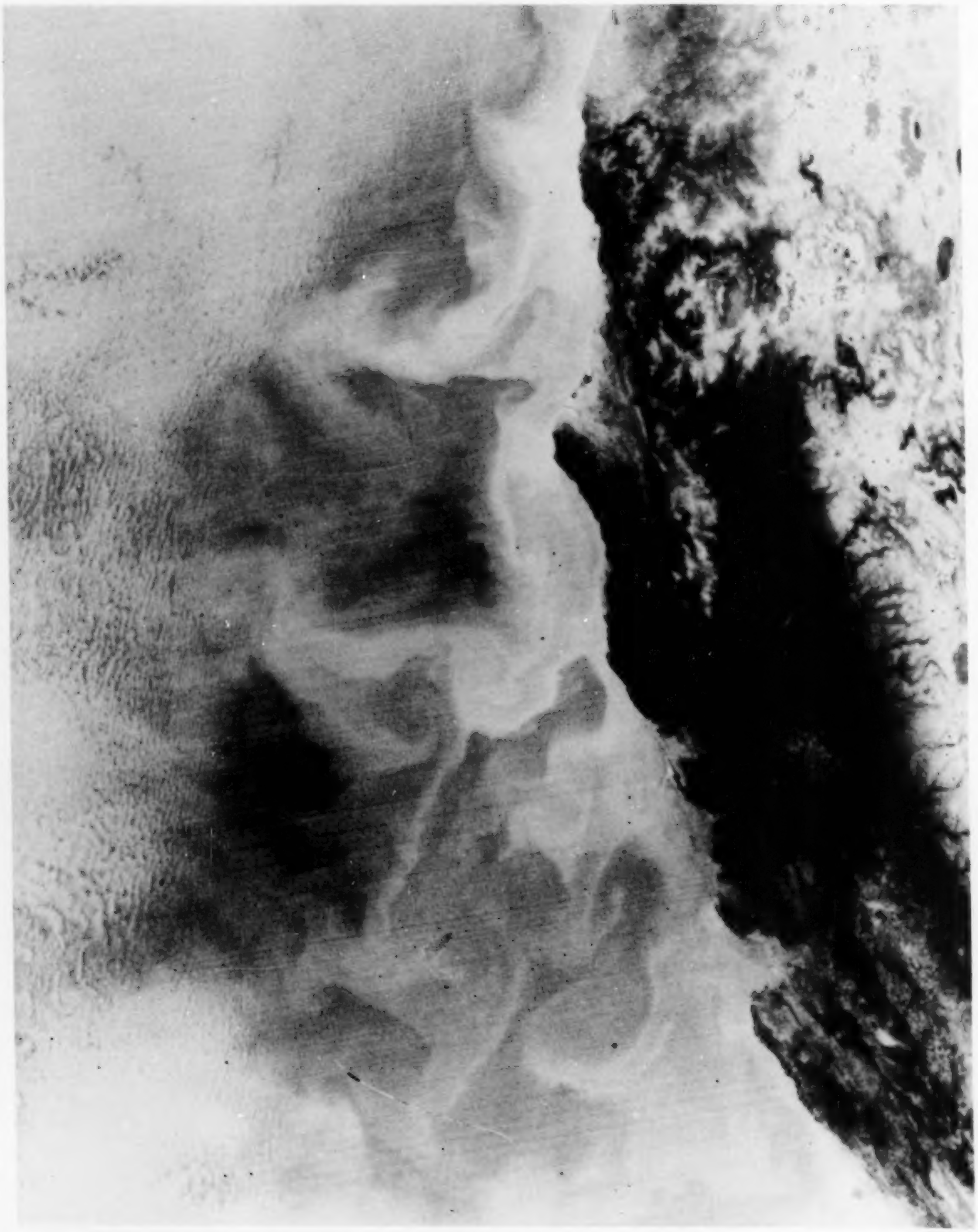

Figure 19.--The intricate patterns of upwelling off the California coast show up clearly in this infrared NOAA 3 satellite picture.

NEW FREEZEUP FORECASTS FOR ST. LAWRENCE SEAWAY

A new technique for predicting ice freezeups in the upper St. Lawrence Seaway is being used operationally with the hope of saving time and money for shippers using the seaway.

The freezeup predictions--tested for 2 yr--use mathematical equations developed at the Great Lakes Environmental Research Laboratory in Ann Arbor, Mich., and based on only two quantities--the current water temperature at the mouth of the St. Lawrence at Kingston, Ont., and the predicted December flow rate and associated heat loss in the river's 100 mi journey from Kingston to Massena, N. Y.

Using the data, NOAA's National Weather Service Forecast Office in Buffalo issues predictions of the freezeup on the 1st and 15th of October, November, and December.

Freezeup predictions 2 to 3 mo in advance could provide shippers the necessary lead time to schedule vessels into and out of the Great Lakes until ice prevents the continuation of normal navigation.

Commercial shipping activity on and into the Great Lakes normally ceases 3 to 4 mo each winter because of extensive ice cover on the interlake connecting channels and the St. Lawrence River. Until now operators of vessels using the seaway have been forced to assume the system above Montreal would not be open after December 15.

Ocean vessels must vacate the seaway system before it is closed or face the prospect of being locked in for 3-1/2 cold, unproductive months.

According to the Environmental Research Laboratories, inadequate attention has been given to annual and seasonal weather variations when establishing the closing date. Records show freezeups vary by as much as 3 wk from year to year.

More than 50 countries presently use the St. Lawrence Seaway. With operating costs running between $3,000 and $5,000 per day for ocean-going vessels, more accurate predictions of the exact closing date at Massena could save thousands of dollars daily. In addition, taking necessary ice control measures at the proper time could prevent serious power losses and shoreline damage.

The prediction technique was developed as part of a 5-yr Federal study--the Great Lakes-St. Lawrence Seaway Navigation Season Extension Demonstration Program--at the request of the St. Lawrence Seaway Development Corporation, which operates the waterway for the Department of Transportation.

NOAA scientists are also developing techniques for predicting the ice breakup date in the St. Lawrence each spring.

NOAA AWARDS ARCTIC RESEARCH CONTRACT

The University of Colorado's Institute of Arctic and Alpine Research has been awarded a 2-yr contract to study the effects of weather and climate on ice along the Arctic's Beaufort Sea coast. The contract is part of a major environmental study that seeks to determine the probable ecological impacts of oil exploration and development activities on Alaska's Outer Continental Shelf.

The primary objective of the research is to assess the role of weather and climate as it affects the extent and seasonal decay of ice fastened to the shore along the Beaufort Sea, that part of the Arctic Ocean on Alaska's northern coast. "Fast" or fixed ice could create potential hazards to offshore petroleum facilities and operations. It also influences the life cycles of those Arctic birds and mammals for whom the ice is a breeding ground, climatic barrier, or migratory route.

Beaufort Sea climatic conditions are among the harshest in North America. Coastal fog and winds persist, accompanied by temperatures as high as 70°F (20°C) in summer and as low as minus 67°F (minus 55°C) in winter.

Ice covers the sea almost completely during the winter, and fast ice extends from a few miles to as much as 30 mi offshore and is frozen to the bottom near shore. Yet little is known about shore-fast ice formation processes, stress changes, and year-to-year variations, and how they are related to specific weather patterns. For example, ice freezeup and breakup dates for the region are variable and unpredictable. At Point Barrow, Alaska, one of the major ports of the region, freezeup may occur anytime between early September and mid-December. The annual ice breakup has occurred as early as mid-June and as late as August.

The University of Colorado research team, in cooperation with the University of Alaska, plans to use remote sensing methods--visual and infrared imagery from satellites and aircraft--to produce regional maps of the fast-ice extent and characteristics for five offshore areas of the Beaufort Sea. The team will collect data around Landsat-II satellite overpasses, using small aircraft to examine some of the ice features more closely. Visual and infrared imagery gathered by aircraft and ground observations of ice characteristics will provide control data for establishing ice classification categories and for validating satellite-imagery interpretations.

By comparing meteorological data with ice information for the five regions, the scientists hope to establish relationships between weather variables such as wind, temperature, precipitation, atmospheric circulation patterns, and ice. They will also determine the frequency of atmospheric circulation type by season, year, and decade, and how the climatic influences on the ice are changing. Probability statements of expected atmospheric behavior associated with ice conditions on the Beaufort Sea coast can then be made.

LIGHT 1975 INTERNATIONAL ICE PATROL SEASON

The International Ice Patrol terminated the 1975 Ice Season on June 24 with no icebergs posing a threat to shipping in the vicinity of the Grand Banks. The season was relatively light with an estimated 100 icebergs drifting south across latitude 48°N. The cooperation of the many vessels that reported iceberg sightings and sea surface temperatures (SST) significantly contributed to the success of that year's Patrol. The value of ship iceberg reports is obvious. The reporting of sea surface temperature is also especially important, since these data make it possible to predict the life expectancy of icebergs.

Listed below are the names and number of reports of 11 vessels that were outstanding contributors during 1975.

VESSELS	ICEBERG	SST	TOTAL
ATLANTIC SPAN	16	26	42
LONDON TRADITION	1	13	14
HURON	--	14	14
MINERAL SERAING	2	11	13
STADT BREMEN	--	12	12
STADT WOLFESBURG	--	11	11
LONDON PRIDE	--	11	11
MANCHESTER CHALLENGE	3	5	8
AMSTELHOF	2	6	8
MELLUMERSAND	2	5	7
JALAMOKAMBI	2	5	7

All vessels are requested to report sea surface temperatures (in addition to sea ice and icebergs) to COMINTICEPAT NEW YORK every 6 hr when within latitudes 40° to 50°N and longitudes 42° to 60°W. When reporting, the following information is requested: SHIP POSITION, COURSE, VISIBILITY, AIR and SEA SURFACE TEMPERATURE, WIND DIRECTION and SPEED. These reports are made through AMVER radio stations, Coast Guard radio stations, or Canadian Coastal Radio Station St. John.

SATELLITE TRACKS NOAA BUOYS IN GULF OF ALASKA

A series of unique buoys, riding the ocean currents in the Gulf of Alaska and signaling data to a satellite overhead, are helping scientists develop a picture of the circulation in the Gulf, in their effort to predict the flow of pollutants from offshore oil development. This effort is part of a large, multidisciplinary environmental investigation being conducted by NOAA for the Bureau of Land Management.

Three buoys were deployed near Yakutat Bay in November by the NOAA Ship SURVEYOR. Scientists from NOAA's Atlantic Oceanographic and Meteorological Laboratories in Miami plan to launch nine more, in groups of three, at roughly 3-mo intervals during 1976.

As they drift, the buoys broadcast information on position, water temperature and surface winds. Their signals are picked up by Nimbus 6, an experimental, polar-orbiting meteorological satellite, as it makes its daily pass overhead, and then fed to NASA's Goddard Space Flight Center in Maryland where each buoy's position is computed. NOAA scientists then incorporate these daily positions and the environmental data into a growing picture of the patterns of currents in the Gulf.

Remotely tracking buoys by satellite vastly increases the scope possible for studies of this sort. Buoys have long been used to trace ocean currents, but in the past had to be tracked visually, by radar or followed by ships. Satellite remote tracking systems can keep "watch" of buoys over huge areas of water.

The buoys, designed and built at Nova University in Dania, Fla., are simple and inexpensive. Each consists of a plastic tube 6 in in diameter and 14 ft long girded by an inverted conical float about 2-1/2 ft in diameter. The tube sits upright in the water, with an apparatus resembling a sea anchor attached to its underwater end to keep it from being blown around by the wind. An antenna atop the buoy broadcasts its bits of information (fig. 20).

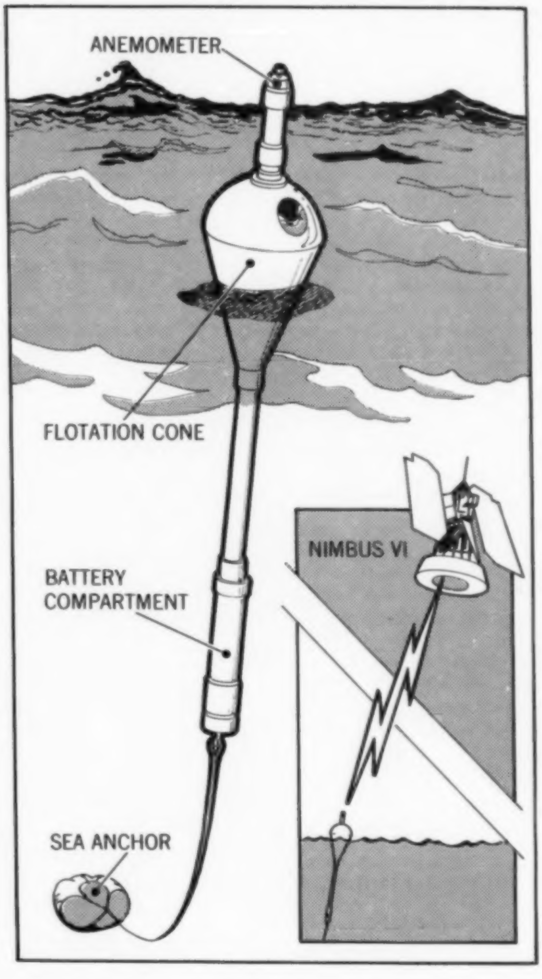

Figure 20.--Sketch of buoy deployed in Gulf of Alaska environmental study.

Each buoy is expected to last several months before the battery that powers it is exhausted. They were designed to be expendable, and it is expected that they will ultimately lose their sea anchors and drift ashore, probably somewhere in the Aleutian Islands.

The buoys transmit randomly in time for about one second out of each minute, thus reducing the possibility of two buoys broadcasting at the same time and jamming each other's signals. This type of system is simpler and less costly than one in which the satellite interrogates each buoy as it passes overhead. Its disadvantage is that the number of buoys that can be placed in a given part of the ocean is limited since the odds that two buoys will be transmitting simultaneously increases as their number increases.

The Gulf of Alaska project is only one of the applications planned for the NOAA buoys. Researchers plan to use them this spring in studies of ocean currents in the Caribbean and the Sargasso Sea.

MONTHLY BULLETIN OF LAKE LEVELS FOR THE GREAT LAKES

The Detroit District Engineer has announced that the Monthly Bulletin of Lake Levels for the Great Lakes is now being published by the Detroit District, U. S. Army Corps of Engineers. Previously, the Bulletin was published by the U. S. Department of Commerce, National Ocean Survey, Lake Survey Center, which will continue to provide the Recorded Water Level Data.

The Bulletin format and some information has been changed:

1. The period of recorded data for maximum, minimum, and average levels is 1900-74 instead of 1860-1974 (1898-1974 for Lake St. Clair).
2. The Lakes Superior and Michigan-Huron maximum levels for the early years (prior to 1900) were replaced with the modern-day maximums.
3. Water level data for Lake Superior will be shown for the Marquette, Michigan, gage instead of the Point Iroquois, Michigan, gage. This resulted in several maximum monthly level changes on the Lake Superior hydrograph.
4. The average levels of the last 10 yr (graphical plot) will no longer be provided since it is believed that it has been of little value to the user.
5. The Channel Depth Forecast was deleted from the Bulletin, but will be provided as a separate bi-monthly forecast. (It is free of charge, and those interested should contact the Detroit office.)

The period 1900-74 is considered to reflect the "modern day" situation, with automatic water level gage data available for most of the period. Prior to that time, daily readings were obtained from a staff gage which provided only a point observation, not the continuous or hourly observations now available. Also, converting to the modern day data will be consistent with the recently published data in the International Joint Commission report on the Regulation of Great Lakes Water Levels and in the Canadian Hydrographic Service's Monthly Water Level Bulletin. It is believed that these changes in the Bulletin are appropriate and will not inconvenience anyone. Contact their office if you have any questions or comments.

PUBLICATIONS OF INTEREST TO MARINERS

U. S. NAVY MARINE CLIMATIC ATLAS OF THE WORLD, VOLUME I - NORTH ATLANTIC OCEAN (REVISED 1974) NAVAIR 50-1C-528

The long awaited revision of Volume I is here. It is available through the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The cost is $23.90.

The eight volume series of the U. S. Marine Climatic Atlas of the World has had wide acceptance as an authoritative reference for large-scale operational planning and applied research. This updated version of the long out-of-print 1955 Volume I includes nearly 20 yr of additional data. It is not a one-for-one revision of the 1955 atlas however. Some of the data presentations have been changed and wave statistics have been added. No upper air charts are presented since in recent years several comprehensive volumes of upper air data have been published separately.

The data for this atlas and the others in this series are obtained from ship's weather observations. In the past three decades the Ocean Weather Station (OWS) networks, maintained through the cooperation of several maritime nations, have provided a good approximation to the "point statistics" of land climatology. Beyond the coverage afforded by the 10 North Atlantic Ocean Weather Stations, there remain vast areas for which transient ships' logs of surface weather observations are the only source of detailed knowledge of ocean climate. The National Climatic Center has taken ship observations collected by the major maritime nations and placed them into one tape deck, Tape Data Family-11 (TDF-11), in a common format. This tape deck was used in the computations for this volume.

The atlas is a monthly, seasonally for some oceanographic data, presentation of isopleth analyses supplemented by graphs and tables. The analyses were completed by a team of analysts under the supervision of the author--Joseph M. Meserve. The basic maps were automatically plotted from one- or two-degree square summaries for the entire ocean area. To supplement the isopleth analyses, graphs and tables are presented for each of the Ocean Weather Stations and selected representative areas.

The atlas contains analyses of winds, air and sea temperatures, precipitation, cloudiness, visibility, humidity, pressure, extratropical and tropical cyclones, and waves. Some of these parameters are also analyzed in various combinations. The oceanographic section presents information on tides, currents and ice.

This volume is the first revision of the series. The next scheduled revision is for Volume III - Indian Ocean.

MARINE WEATHER REVIEW

The SMOOTH LOG (complete with cyclone tracks [figs. 23-26], climatological data from U.S. Ocean Station and Buoys [tables 7 and 8], and gale and wave (tables 9 and 10), is a definitive report on average monthly weather systems, the primary storms which affected marine areas, and late-reported ship casualties for 2 mo. The ROUGH LOG is a preliminary account of the weather for 2 more recent months, prepared as soon as the necessary meteorological analyses and other data become available. For both the SMOOTH and ROUGH LOGS, storms are discussed during the month in which they first developed. Unless stated otherwise, all winds are sustained winds and not wind gusts.

Smooth Log, North Atlantic Weather

July and August 1975

SMOOTH LOG, JULY 1975--This was a near-normal month over the major shipping lanes. The number of cyclones and the pattern of their tracks very closely resembled climatology. The primary track that affected shipping extended eastward from Labrador to about 40°W, then northeastward toward Iceland. There were less traveled tracks across Scotland and into Baffin Bay. The majority of the storms occurred the first and last weeks of the month.

The Bermuda-Azores High was the outstanding pressure feature, at 1026 mb, centered near 35°N, 50°W. Its anticyclonic circulation dominated from the Great Plains of the United States to the Urals of Russia, and from 15° to 50°N. These are gross boundaries.

In the oceanic area of primary interest, south of 60°N, there were no anomalies greater than 3 mb, and they were mostly positive.

North of 60°N, the negative anomalies were large because of much lower pressure than normal from both Baffin Island and the Greenland Sea toward the North Pole. The lowest pressure was 1000 mb, near 82°N, 100°W, while climatologically the Low is 1008.6 mb near 62°N, 70°W. The largest anomaly was minus 12 mb, near 82°N, 100°W. There was a minus 8-mb center over the Greenland Sea, and a minus 5-mb near 64°N, 30°W.

Hurricane Blanche formed over the Sargasso Sea on the 24th.

Extratropical Cyclones -- The only really significant cyclonic storms this month were the two tropical cyclones -- Amy, which formed in June, and Blanche. The Bermuda-Azores HIGH stood out as the dominant pressure system and circulation even on the individual synoptic charts. There was no storm even approaching the "Monster of the Month" category.

This storm formed as a 1010-mb wave, on the 9th, near 46°N, 46°W. It moved eastward across the top of the HIGH with winds of strong-breeze force. On the 11th, the center turned northeastward and started deepening. The circulation also expanded as the HIGH drifted southeastward.

At 0000 on the 12th, the 992-mb storm was centered near 50°N, 19°W, and stationary. The KLAUS SCHOKE was near 51°N, 22°W, with 35-kn gales. The LOW remained stationary for about 48 hr and, on the 14th, moved over northern Scotland. On the 15th, a small center developed in a trough trailing southwestward out of the LOW. At 1200, the SPEYER, at 49°N, 24°W, about 150 mi southwest of the new center, found 35-kn gales.

By the 16th, the new center could no longer be analyzed, as the original LOW moved into Sweden.

The weather was so mild this month that I am reduced to mentioning individual wind reports. During the middle of the month, the Bermuda HIGH was centered near 40°N, 60°W, at about 1033 mb. The gradient on the north side increased as two weak parallel fronts drifted southward. At 0000 on the 15th, the drilling ship VC 8062 measured 35-kn westerly winds, at 0000 on the 15th.

A wave developed, on the 16th, on the northern of two fronts previously mentioned, and moved eastward with no severe weather. On the 17th, another wave developed on the front, north of Trinity Bay. The HIGH was weakening and drifting southward. By 1200 on the 18th, it was 992 mb near 54°N, 32°W. On the 19th, the center took a northeasterly course and, at 1200 the SALTERSGATE (56.5°N, 28°W) was hit by 45-kn winds, 7-ft seas, and 16-ft swells. The HOEGH MIRANDA, near 53.7°N, 28.7°W, found 35-kn northwesterlies and 8-ft seas. At that time, the LOW was at 59°N, 26°W.

At 0000 on the 20th, Ocean Weather Station LIMA (which replaced INDIA and JULIETT) measured 40-kn gales and 18-ft seas. The LOW was moving due north and, by the 21st, this center disintegrated into several small centers.

This LOW formed in a col area south of Kap Farvel, late on the 19th. The previously described LOW was to the east, and another was centered near Disko Island, Greenland. The LOW moved eastward at a pressure of about 990 mb. At 0000 on the 21st, it was near

59°N, 20°W. Ocean Weather Station LIMA, at 56.5°N, 20°W, had 35-kn gales, which were whipping up 16-ft seas and 20-ft swells.

On the 21st, the LOW moved to the east of Iceland and then eastward. It increased its area of circulation, absorbing the remains of the previously mentioned storm. On the 22d and 23d, the center stalled near 63°N, 07°W, as a minor LOW moved around its southern edge. The AMERICAN LEGEND was southwest of this minor LOW, at 48.9°N, 10.5°W, and near the front. The wind was 35 kn and seas 16 ft. On the 24th, this new LOW became the primary cyclone.

Another report of a single wind: The 40 kn was reported by the GOLDEN ORCHID, near 47.5°N, 34°W, at 1200 on the 28th. The 1030-mb Bermuda-Azores HIGH was stationary near 41°N, 37°W. A cold front lay about 60 mi to the south. Both seas and swells were coded as 7 ft.

Tropical Cyclones--Blanche, the season's first hurricane, had its beginnings as a tropical wave which moved off the coast of Africa on July 14. As the wave entered the Caribbean region, it appeared to elongate and then divide into two systems. One part tracked northwestward as a cloud mass from which a depression formed, about 500 mi north of the eastern tip of the Dominican Republic, on the 24th. The southern part continued westward across the Caribbean Sea and the Yucatan Peninsula, and formed a tropical depression in the southwestern Gulf of Mexico on the 25th.

The first depression gradually turned toward the north and north-northeast, during the next 2 days. In this interval, reconnaissance and satellite data indicated that it hovered on the brink of becoming a tropical storm. The threshold was probably crossed during the early hours of the 26th, when a reconnaissance aircraft found a central pressure of 1004 mb. This point marks the beginning of tropical storm Blanche on the official track. Meanwhile, the second depression intensified as it crossed the southwestern Gulf of Mexico, and was on the verge of becoming a tropical storm when it passed over Tampico, Mexico, later the same day.

As Blanche turned toward the northeast, its potential for further intensification was dependent upon the impact of an approaching cold front moving off the North Carolina coast. However, the front rapidly weakened before cooler air could penetrate the storm's inner core, and Blanche steadily deepened, partly in response to the baroclinic effect of an upper trough to the west. Blanche reached hurricane strength as the central pressure fell to 987 mb, during the early hours of July 27. At this time, the hurricane was at the same location as tropical storm Amy 2 wk earlier.

Whereas Amy followed a meandering track toward the northeast, Blanche moved north-northeastward toward Nova Scotia. As a deepening upper trough moved through eastern Canada, Blanche accelerated to a forward speed of about 25 kn at the time of landfall at Cape Sable, Nova Scotia, about daybreak on the 28th.

During the 12 hr prior to landfall, the hurricane reached its maximum intensity. Highest sustained winds were about 75 kn, and the lowest pressure was 980 mb. The BIBB measured 56-kn winds and 20-ft swells at 0300 on the 28th near 40°N, 67.8°W and a pressure of 992.5 mb very near the center. The MIECZYSLAW KALINOWSKI encountered 50-kn winds at 1200, some 60 mi southwest of the eye.

The lowest pressures at land stations were 987 mb at Western Head, near Cape Sable, at 1330 on the 28th, following a 3-hr pressure fall of 16 mb; and 988.7 mb at nearby Shelburne, at 1200, after a 3-hr fall of 18 mb. Some maximum wind measurements are: Halifax, sustained winds of 45 kn, with gusts to 70 kn, at 1422; Western Head, sustained winds of 47 kn at 1200; and Grindstone Island, sustained winds of 61 kn at 1800.

There was no loss of life due to Blanche. Considerable minor damage occurred, mostly in eastern Nova Scotia, consisting mainly of small boats washed ashore, and trees blown down. Rainfall was not excessive. The greatest accumulation was 3.1 in, in Chatham, New Brunswick. The rains proved beneficial, bringing an end to a prolonged dry period over the region.

Casualties--The British-registered 1,787-ton TORTUGAS sank in heavy weather, about 30 mi southwest of Santorin Island after taking a sudden list. The crew was rescued. The Cypriot-registered DELPHI grounded as a result of a sudden squall, at Matazanas Bay, Cuba. An estimated 70 persons were drowned when a motorvessel carrying about 100 passengers sank in a storm, near the mouth of the Lakoundje River, on the 10th. It was enroute from Douala, Cameroon, to Libreville, Gabon.

SMOOTH LOG, AUGUST 1975--The paths traced by the centers of the cyclones this month were near normal. The main area of activity was over Canada. Some of this activity moved northeastward toward and into Baffin Bay, while some moved eastward across the Labrador Sea toward Iceland and the Norwegian Sea. Several storms moved eastward across the U.S. Atlantic coast, where there was a flurry of activity south of Newfoundland. These storms then moved northeastward.

The monthly mean sea-level pressure pattern was nearly a carbon copy of climatology, except over the North Pole. The Azores High, at 1023 mb, extended slightly farther to the northeast than usual, into the Bay of Biscay. The Icelandic Low, at 1006 mb, was near 60°N, 30°W. There was also an area of weak low gradient over northern Quebec and Baffin Island. A 1002-mb LOW was centered near the North Pole.

The largest anomaly was 4 mb, of which there were several. A negative 4-mb was centered near 60°N, 30°W, with the LOW. A trough south of Newfoundland produced another negative 4-mb near 40°N, 50°W. The 4-mb isoline extended about 500 mi southwestward from the English Channel, then curved back over the Faeroe Islands to enclose a larger anomaly over Scandinavia.

The 700-mb surface was near normal. The troughing normally over the U.S. east coast was slightly sharper, and off the coast rather than over it. The primary gradient and wind band spanned 40° to 60°N over the ocean. The major anomalies were a negative center south of Newfoundland and a positive center over Scandinavia.

Hurricanes Caroline and Doris developed late in the month.

Extratropical Cyclones--There were several LOWs over the Grand Banks, early on the 1st. Later in the day, the reports indicated they had combined into one center, near 40°N, 55°W. At 0000 on the 2d, the BENEFACTOR, to the west of the center, reported lightning and 20-ft swells. The pressure gradient around the center was weak, and the only front was miles to the north. The center drifted southward and westward until, on the 3d, it reversed itself and drifted northeastward.

The first gale-force wind was observed by the IMPERIAL QUEBEC off Halifax on the 5th. On the 6th, the LOW became associated with the upper-air zonal flow and started moving eastward. At 1200 on the 7th, the AMERICAN RANGER was near 41°N, 44°W, with 35-kn gales. On the 8th, the NORBROTT also found 35-kn gales south of the center. It was about this time that the circulation consolidated around the LOW, as the pressure dropped and the center took a northerly track. At 0000 on the 11th, Ocean Weather Station "C" measured 40-kn winds. On the 12th, the BAKHCHISARAY observed 20-ft seas at 56°N, 33°W. About this time, the center took an abrupt turn to the east and passed very near OWS LIMA. The LOW was weakening, as it slowly but steadily moved eastward and over Scandinavia on the 17th.

A very small, closed, 1008-mb isobar first identified this LOW, west of Lake Winnepeg, on the 3d. There was little development as the small circulation moved eastward, until late on the 4th. After passing the southern tip of James Bay, the storm started curving northward. At 0000 on the 6th, the 994-mb center was over Cape Chidley. Twelve hours later, it was over Cumberland Sound. A ship near 65°N, 55°W, had 45-kn southerly winds blowing over very cold water. The waves were reported as 13 ft. To the south, near 62.5°N, 53°W, the WALTHER HERWIG had 40-kn winds stirring up 16-ft waves. The track of the storm continued curving westward, and this was the beginning of the end.

On the 4th, a cold front extended southwestward out of a LOW near Iceland. At 1200, a wave was analyzed, near 48.5°N, 26°W, with the aid of reports from the FORT PONTCHARTRAIN (30 kn) and the UGMJ (40 kn). Twelve hours later, at 0000 on the 5th, the central pressure of the LOW had plunged to 992 mb. The UGMX reported 35-kn gales west of the center, near 48°N, 30°W.

The LOW was moving northward with little change in pressure, but its circulation had expanded greatly. At 1200 on the 5th, the AMERICAN ARCHER, near 49.7°N, 19.2°W, was sailing into roaring 65-kn westerlies. The seas and swells were 20 ft. The SEA-LAND PRODUCER was near 48.5°N, 29°W, with 35-kn gales. Several ships around the storm reported 30-kn winds. At 1200 on the 6th, the SWEDISH PLANE was blown by 35-kn southwesterlies.

The LOW moved toward the north and passed over the western peninsulas of Iceland, on the 9th, with only weak winds. The storm continued northward, to disappear over the Greenland Sea on the 12th.

This system had its origin in several sources. One was a frontal wave that developed over Kansas, on the 13th, and moved eastward along the front until it was a 1006-mb LOW south of Nova Scotia on the 19th. Another source was a LOW that came out of central Canada to northern Quebec on the 19th. This was the larger of the two LOWs. The third element was a HIGH which had moved from the U. S. east coast to near 45°N, 40°W. At 1200 on the 19th, the CETRA COLUMBA was rolled by 40-kn southerlies on her port side, near the apex of an occlusion out of the southern LOW. The HUDSON was north of Notre Dame Bay, with 35-kn southerlies ahead of the front out of the Canadian LOW. At 1200 on the 20th, the SEA-LAND RESOURCE was near 50°N, 40°W. The winds were 35 kn out of the south, with 15-ft seas. By the 21st, the smaller LOW was absorbed by the larger circulation.

This storm came out of Nebraska. It picked up some energy as it crossed the Great Lakes on the 21st. Late on the 22d, it moved offshore of Nova Scotia at 1002 mb. It quickly developed over the water and, at 1200 of the 23d, was 988 mb near Cape Race. The ATLANTIC CHAMPAGNE was southwest of the center, near 45°N, 57°W, and being battered by 50-kn winds. The waves were 15 ft. Just a few miles away, the VIKTOR LYAGIN radioed 40-kn winds and 13-ft waves. Twelve hours later, the center was near the Virgin Rocks, and the ALINDA, near 50°N, 49°W, fought 40-kn northerly winds.

At 1200 on the 24th, the 980-mb center was near 49°N, 45°W. The GYPS, at 54°N, 41°W, was north of the occluded front, with 45-kn northeasterly winds. The IVAN AIVAZOVSKY, north of Newfoundland, suffered 40 kn, and the VC 8062, off St. John's, had only 35 kn, but the swells were running 20 ft. The AMERICAN LEGEND, at 43.6°N, 45.8°W had 45-kn gales.

As the LOW continued northeastward, gales were reported in all quadrants. The NEW ENGLAND TRAPPER (49°N, 38°W) had 35-kn gales and 23-ft swells, south of the center. At 0000 on the 26th, the LINDA DAN sailed within a few miles of the 986-mb center and into 45-kn winds, with 21-ft seas. As the storm approached Iceland, it was weakening rapidly, and the passage over the island spelled the end.

A LOW was analyzed over Lake Michigan, on the 1200 chart of the 29th. It moved due east and off the coast, at 1800 on the 30th. At 0000 on the 31st, the FRITHJOF encountered 35-kn gales off Cape Cod. At 1200, the 1004-mb LOW was at 41°N, 60°W. The BILDERDYK, about 60 mi north of the center, sailed into 40-kn winds and 13-ft waves. She was sailing northeastward at about the speed of the LOW and, at 0000 on September 1, still had 40-kn gales. The seas were running 13 to 15 ft. On the 2d, the GEORGE WALTON and NORDIC TALISMAN both had 35-kn gales, west and south of the center, respectively.

The LOW turned northward to pass over Newfoundland, on the 3d, as hurricane Doris, to the southeast, moved northward.

Tropical Cyclones--Late August saw hurricane Caroline come to life in the Gulf of Mexico, and hurricane Doris develop in the northern North Atlantic.

Caroline began as a weak tropical wave. Satellite pictures, on the 28th, suggested that she was becoming organized. An Air Force plane was sent out to investigate and found tropical storm Caroline some

400 mi east-southeast of Brownsville, Tex. She was heading toward the west-northwest. The threat to the Texas coast was compounded by the upcoming Labor Day weekend, with its numerous seashore activities. Caroline plodded on. By Friday morning, the 29th, she reached hurricane intensity about 275 mi east-southeast of Brownsville. Winds climbed to 65 kn around her 995-mb center. For awhile, on Friday, she was stationary. Then, Saturday morning, she began to move westward toward the Mexican coast and continued to intensify. At 1300 on the 30th, the hurricane was 200 mi southeast of Brownsville. Winds climbed to 100 kn around her 963-mb pressure center before Caroline reached the coast, midway between Tampico and Brownsville, early Sunday Morning (1000). She spread heavy rain throughout northeastern Mexico and into southern Texas. Storm totals of 10 in were common, as the decaying storm turned northward after landfall. On Sunday alone, Brownsville recorded 5 in of rain. The rains continued through Monday, as the system made its way into south Texas.

Doris began as a small subtropical LOW in the middle North Atlantic on the 27th. It was not until late on the 30th that she acquired tropical characteristics, near 35°N, 46°W. She was already of hurricane intensity, as 65-kn winds roared around a 990-mb center. Gales extended out 150 mi in all directions. The IRISH MAPLE, some 50 mi or so south of the center, encountered 40-kn southwesterlies. Maximum winds climbed to 75 kn, as Doris briefly swung east-southeastward on the 31st. Moving northward, Doris reached peak intensity, on the 3d, when maximum winds were estimated at 95 kn, with gales and 15-ft-plus seas extending out 150 mi in all directions. However, cold air was intruding, and Doris began to weaken and turn extratropical, on the 4th, after crossing the 40th parallel near 43°W.

Casualties--There are no weather-related casualties known at this time.

Smooth Log, North Pacific Weather

July and August 1975

SMOOTH LOG, JULY 1975--The cyclone tracks this month were diverse, and fewer in number than normal. They moved eastward from the Japanese Islands to about 180°, and then northeastward toward Alaska. The climatological track is northeastward from Japan into the Bering Sea.

High pressure was the dominant feature over the majority of the ocean. A 1025-mb HIGH was centered near 35°N, 153°W, compared to the 1026-mb climatic High near 39°N, 150°W. A small 1008-mb LOW was centered near 53°N, 180°, with a trough indenting the HIGH as far south as 40°N. The mean climatological pressure pattern does not indicate a closed Low over the marine area.

The major anomaly centers were both negative: a 9-mb centered near 48°N, 175°W, associated with the trough, and a 6-mb near 51°N, 150°W, associated with another trough in the Gulf of Alaska.

The upper-air pattern was near normal except for the reflection of surface troughing. Climatology indicates troughing at 700 mb over the western Bering Sea, with a south-southwestern orientation. This month, there was a closed circulation near 54°N, 179°W, with a southerly trough, and another near 56°N, 148°W, with a southeasterly trough off the North American west coast.

There were four tropical cyclones over the eastern North Pacific: hurricane Carlotta, hurricane Denise, tropical storm Eleanor, and tropical storm Francene. The western North Pacific hosted tropical storm Mamie and supertyphoon Nina.

Extratropical Cyclones--In the first week, a LOW had moved up the Kuril Islands from Japan. At 0000 on the 4th, the JAPAN MAIL recorded 50-kn winds at 33.4°N, 138°E, near one of the minor stable waves moving along the front. At 1200 on the 6th, a 999-mb LOW was analyzed near 45°N, 165°E, at the point of occlusion. This LOW moved southeastward with near-gale-force winds. At 1200 on the 7th, the 993-mb LOW was near 42°N, 177°E, and the PRESIDENT VAN BUREN was near 38.5°N, 179.5°W, with 35-kn winds and 13-ft seas.

By the 8th, this LOW had expanded its circulation by absorbing the parent LOW. The CORNELIA MAERSK was well to the south, near 34°N, 173°E, with 35-kn gales. At 1200, the SEA-LAND COMMERCE (39°N, 170°W) had heavy rain and gales. The LOW was now moving north-northwestward. The center crossed the Aleutians near 177°W, about 0600 on the 9th. At 1200, the GAVRIIL DERSHAVIN, just south of the Andreanof Islands, found 35-kn northerly winds. At 0000 on the 10th, Cold Bay recorded 35-kn winds from the south. On the 11th, the LOW stalled near 57°N, 180°, and filled.

A frontal wave was the origin of this LOW. It moved almost due eastward across the top of a weak HIGH. It had deepened slowly and at 0600 on the 5th was near 42°N, 174°W at 1000 mb. It was now pushing against a 1037-mb HIGH south of the Gulf of Alaska and turning northward. The SANKOSUN was at 42.7°N, 171.2°W and measured 40-kn winds and 26-ft waves. As the LOW moved northward, it filled and disappeared on the 7th.

This storm formed over the Sea of Japan, late on the 10th. It raced along the 39th parallel until late on the 12th, when it turned northeastward. At 1200 on the 13th, the 986-mb LOW was near 48°N, 177°W, and the SEIUN MARU (40°N, 174°W) and the ZEEBRUGGE (35.5°N, 174°E) both reported 35-kn gales just east of the front. The JAPAN BEAR, at 44.2°N, 165.3°W, measured 48-kn southerly winds and 10-ft waves. At

0000 on the 14th, the HONGKONG SUCCESS found 40-kn gales along the front on her westerly track.

The LOW moved over the Alaska Peninsula on the 15th, and eastward into the Gulf of Alaska on the 16th. It was filling, and only breezes were blowing around its center.

The Gobi Desert spawned this LOW on the 17th. It moved over the Sea of Japan, on the 20th, a well-developed storm at 990 mb. At 0000 on the 21st, it was over the Bering Sea north of Ostrov Beringa. The TOYOTA MARU No. 11 was near 51°N, 165°E, and slightly south of the cold front, with 35-kn gales and 13-ft swells.

The LOW was moving very slowly toward the east over the cold water. The JAPAN MAIL was north of Umnak Island, at 0000 on the 22d, and was being tossed by 45-kn winds. The DAIHO MARU was south of the center and north of Kiska Island, with 35-kn winds. The LOW drifted eastward and disappeared on the 26th.

A LOW formed in the col area over the Bering Sea between two HIGHs. It moved southeastward and then northeastward, late on the 21st. On the 22d and 23d, it stalled near 51°N, 151°W, and deepened to 983 mb. At 0000 on the 23d, the VAN CONQUEROR (50°N, 139°W) was washed by heavy rain and 40-kn winds. Northwest of the center (55°N, 154°W), the JAPAN MAPLE had 35-kn gales supporting 16-ft seas and 18-ft swells. At 1200, the HILLYER BROWN was off Chignik, Alaska, headed toward Kodiak Island, with 45-kn northerly winds. The waves were 15 ft.

On the 24th, the LOW was moving northeastward again, but filling. The PORTLAND at 54.7°N, 139.1°W, at 0000 on the 25th, found 50-kn winds, 12-ft seas, and 20-ft swells. By the 27th, it no longer existed.

Tropical Cyclones, Eastern Pacific--As tropical storm Bridgette passed 100 mi south of Clarion Island, headed west-southwestward, an area of squalls and thunderstorms began developing 420 mi south-southeast of Acapulco. The cloudiness was moving westward at about 10 kn, and development was indicated in the forecasts. Special bulletins were begun, at 0600 on the 2d, for tropical cyclone Three, forecast to become a tropical storm in 24 hr. The KOPAA reported 25-kn winds in squalls 130 mi north of the center, at 0900 on the 2d, and 35-kn winds 150 mi northeast of the center, at 1500. The later report suggested tropical cyclone Three had intensified to tropical storm Carlotta, and advisories were issued.

Further intensification was almost in textbook style. The storm was moving toward the west-northwest and northwest, at 10 to 12 kn, becoming a hurricane with 65-kn winds, near 12.5°N, 108.2°W, by 1800 on the 3d, and 100- to 110-kn winds from 0000 on the 5th, at 15.8°N, 111.7°W, through 1800 on the 6th, at 17.3°N, 117.9°W.

Weakening began, about 0600 on the 6th, but the ERIDGE reported south-southwesterly winds of 45 kn, 200 mi southeast of the center, at 1200 on the 7th, when the hurricane still supported winds of 75 kn. Tropical storm intensity began, at 0000 on the 8th, near 17.4°N, 121.3°W, with the center moving west-northwestward at 8 to 10 kn. The ERIDGE passed 60 mi north of the center, at 2100 on the 8th, with 35-kn winds. The SHINYU MARU and DAISHIN MARU both reported well south of the center, at 0000 and 0600 on the 8th, but these reports indicated no more than a storm at some distance to the northwest.

The KRAIGHERB passed 120 mi north of Carlotta, at 0900 on the 9th, with 30-kn winds. When about 200 mi east of the center, she altered her course to pass south of oncoming Denise, 900 mi east-northeast of Carlotta.

No vessels were near the center of a large unstable area near 11°N, 93°W, at 1800 on the 4th, but reports from the AMERICAN LANCER, CHEVRON AMSTERDAM, KOPAA, and the SAN JUAN EXPORTER indicated a circulation had developed. The depression was followed west- and northwestward on satellite pictures and charted with the aid of peripheral reports from the AMERICAN LEADER, ASTRID BAKKE, CEDARBANK, CHEVRON AMSTERDAM, MARITIME CHALLENGE, NEDLLOYD DELFT, PRUD OCEANJET, RICE QUEEN, SANTA MAGDALENA, and the UNIWERSYTET WARSAWSKI, as a tropical depression through 1800 on the 6th, near 13°N, 101°W.

The depression intensified to tropical storm Denise, at 0000 on the 7th, with 45-kn winds reported by the PGXY, 30-kn winds by the EURYBATES, and 20-kn winds by the PRUD OCEANJET. As the storm reached 15°N, 103°W (200 mi south of Manzanillo), at 0000 on the 8th, its course changed to more westerly. At this time, the storm was considered a hurricane. Although winds along the coast, from Cape Corientes to Acapulco, are normally strong southeasterlies under these circumstances, they were reported as only 15 to 25 kn. The hurricane steadily increased in intensity to 120 kn, by 1200 on the 9th, with the strongest reported wind only 30 kn by the PLEIAS and the FIDELITY at 1800 on the 9th. The track of the hurricane then changed to southwesterly, and it weakened slowly. The PSDY sent a SHRED report of northwesterly winds of 45 kn, from 150 mi west of the center, at 0000 on the 10th. The storm continued southwestward, slowly weakening and becoming nearly stationary from 1800 on the 10th to 0600 on the 11th, near 13.7°N, 113.5°W. After the 12-hr "stationary" period, Denise began moving northwestward at about 10 kn.

The CABRILLO, a tuna boat just off Clarion Island at 1800 on the 11th, was heading southwestward, as Denise, with 80-kn winds some 200 mi to the south, was moving northwestward. The CABRILLO, aware of the location and intensity of the storm, contacted the Hurricane Center for information and advice. The storm and boat were on an intercept course, with the meeting scheduled for 0500 on the 12th. The advice was to sail eastward for 6 to 12 hr and then resume the southwesterly course. The CABRILLO reports regularly in the Tuna Fleet and is an old hand at evading tropical cyclones.

The CETRALYRA was headed northwestward about 100 mi east of the hurricane, at 0000 on the 12th, and was moving at about the same speed as Denise. She reported 40-kn winds. These increased to 60 kn, by 0000 on the 13th, when the CETRALYRA reported the lowest pressure in the storm--993 mb. She altered her course to pass 120 mi south of the center, at 1800 on the 13th, with 30- to 40-kn winds.

By the time Denise reached 19.9°N, 118.8°W, she had weakened to tropical storm intensity, becoming a depression near 21.2°N, 118.8°W. She dissipated 12

hr later.

A persistent area of thunderstorms 120 mi south of Acapulco, at 1800 on the 10th, led to issuing a bulletin on tropical cyclone Six. Movie loops of satellite pictures showed cyclonic circulation with signs of intensification, so the cyclone was upgraded to tropical storm Eleanor. Acapulco reported 30-kn winds, at 1200 and again at 1800 on the 10th, but vessels reporting in the area were not numerous enough to pinpoint the location of the center.

Eleanor moved north-northwestward for 6 hr, northwestward for 18 hr, and then northward to go on shore near Manzanillo, at about 0000 on the 12th. At that time, the LUDWIGSHAFEN reported a 998.8-mb pressure and a south-southwesterly 35-kn wind, about 75 mi southeast of the center. The FERNFIELD reported 30-kn winds, 30 mi southwest of the center; the A8MW, a westerly 30-kn wind, 30 mi south of the center; and Manzanillo, a westerly 15-kn wind, 20 mi northwest of the center.

No damage was reported to vessels, and it is not believed rainfall was heavy enough to cause more than minor damage to shore installations.

Tropical storm Francene began as a disturbance near 11.5°N, 95°W, about 1200 July 25, moving northwestward at 20 kn, with winds of 30 kn in squalls. The disturbance continued on a northwesterly track, but slowed as it organized and intensified to tropical depression Seven, at 0600 on the 27th, near 16.4°N, 102.8°W. The track became more westerly, and the disturbance developed to tropical storm intensity near 16.5°N, 104.5°W, at 1800 on the 27th.

A westerly movement of 10 kn continued for 24 hr, to 16.4°N, 107.5°W, when Francene weakened to a depression with 25-kn winds. A northwesterly track began at 1200 on the 29th, and its speed increased to 15 kn as weakening continued. By 0000 on the 30th, only a minor circulation was indicated in satellite pictures, so bulletins were discontinued. A tropical disturbance was indicated in high seas bulletins for another 12 hr; then even those were dropped.

Tropical Cyclones, Western Pacific--Mamie and Nina broke a 6-mo tropical cyclone drought, in late July. Mamie, a weak tropical storm, popped up on the 27th, just south of Iwo Jima, while Nina, a potent supertyphoon, came to life on the last day of the month, in the middle of the Philippine Sea.

Mamie traveled a west-northwesterly course, but lasted just 3 days. Her strongest winds were estimated at 35 kn on the 28th. By the time she reached the Ryukyus, all that was left was a weak depression.

Nina was another story altogether. Before July was finished, Nina was a tropical storm. Before August was a day old, she was a typhoon. Her course was west-northwesterly toward Taipan. Nina reached supertyphoon strength, on the 2d, when 130-kn winds blew close to her center. Gales extended out to 200 mi--nearly 500 mi in the northeastern quadrant. This was her peak, since she was fast approaching landfall. On the 3d, Nina, still a typhoon, crossed Taiwan, made the short hop across the Formosa Strait to mainland China, and continued to weaken.

Casualties--The 10,043-ton Liberian ORIENTAL ARGOSY ran aground during heavy weather at San Jose, Guatemala on the 9th. A Liberian vessel identified as the 9,367-ton UNITED WARRIOR sustained cracks during heavy weather in the Indian Ocean during June. The vessel arrived at Jeddah and was beached on July 1, but it sank on the 11th. The freighter TSUKIBOSHI MARU (423 tons) and the ore carrier KINOKUNI MARU (35,774 tons) collided in dense fog on the Inland Sea, on the 16th. Two crewmen were injured. Two other vessels collided off Kashima Port that day, with no casualties. They were the 997-ton KOWA MARU and the 1,272-ton No. 12 TOZAI MARU.

The British-registered KANISHKA, Houston for Calcutta, reported heavy-weather damage on her voyage.

SMOOTH LOG, AUGUST 1975--The storms this month originated farther north than normal, south of Kamchatka rather than off Honshu. These tracked eastward along the Aleutians and into the Gulf of Alaska rather than the Bering Sea. The midocean, 35° to 40°N, 180°, contributed more storms than usual, and they generally moved northeastward.

The mean sea-level pressure pattern was near normal in overall appearance, but the minor differences made the difference. The Pacific High was near 40°N, 150°W, its normal location, but was 4 mb higher, at 1028 mb. There was no closed Low over the Bering Sea to match the usual 1008-mb center, but the pressure over the Gulf of Alaska was less than the climatic mean.

The largest positive anomaly was 5 mb off the northern California coast. The ocean area from the U.S. west coast southwestward to beyond 180° was covered by higher than usual pressure. A positive 4-mb was centered over the Bering Sea, near 60°N, 175°W. The southern Gulf of Alaska supported a negative 3-mb center; the western Sea of Okhotsk, a negative 6-mb; and a negative 5-mb was near Taiwan.

The monthly mean height of the 700-mb surface was slightly higher than climatology across the vast majority of the ocean, except for the Gulf of Alaska and the seas off southeastern Asia. The negative anomaly over the Gulf of Alaska was because of a short wave trough in the monthly mean over that area.

There were five tropical cyclones over the eastern ocean--tropical storms Georgette and Hilary, and hurricanes Ilsa, Jewel, and Katrina. The western ocean hosted four tropical cyclones: typhoons Ora, Phyllis, and Rita, and tropical storm Susan.

Extratropical Cyclones--An old, weak front extended east-west along the southern Alaska coast, on the 7th, as a minor north-south trough moved eastward across the gulf. On the 8th, a distinct LOW formed over the Kenai Peninsula. By 1200, it had moved southeastward into the gulf. Ocean Weather Station "P" measured 40-kn winds at that time. The LOW did not have a good energy source or upper-air support; therefore, it did not intensify, but drifted in the area until overtaken by a more vigorous LOW on the 10th.

The lineage of this storm can be traced back to beyond the 1st and interior Asia. This particular LOW formed

on the periphery of the old system, on the 6th, near Mys Lopatka. On the 7th, Ostrov Paramushir measured 40-kn northerly winds. The LOW moved steadily eastward, with no significant winds or waves until the 11th.

On the 10th, the Pacific HIGH had split into two cells, with the eastern one moving to off the United States-Canadian coast on the 11th. This blocked further eastward movement of the 990-mb LOW. Several 35-kn winds were reported between the HIGH and the northern California coast.

On the 12th, the CHINA BEAR had passed eastward through the front near 42°N, 146°W, and encountered 35-kn southerly winds. The PORTLAND, in the gulf, also had 35-kn winds. The SEA-LAND COMMERCE was near the LOW's center, at 52.5°N, 157°W, and found 33-ft confused swells. The PORTLAND was steaming southeastward into 40-kn gales, at 0000 on the 13th. They were accompanied by an obscured sky and heavy drizzle.

The LOW was now moving west-northwestward and, on the 13th, was once again over the Bering Sea, where it rapidly deteriorated.

This low-pressure area developed, on the 17th, on the east side of another LOW that had stalled north of Adak Island. Far to the south along the front (42°N, 164°W), the RU YUNG encountered 35-kn gales. The LOW remained quasistationary near 55°N, 168°W, at about 997 mb. A frontal wave moved around the edge of the system, and the two combined, on the 18th, near 55°N, 164°W. The PORTLAND was either still or again in the area (56.7°N, 144.2°W) with 40-kn gales. The KOREAN MAIL was near 50.5°N, 163.5°W, at 0000 on the 19th, and was rocked by 45-kn winds with 10-ft waves on her stern. Later that day, the storm moved northward, then eastward, to dissipate on the 20th.

The Tatar Strait produced this LOW on the 17th. After crossing the Kuril Islands on the 18th, the TOYOTA MARU reported 35-kn gales ahead of the front, near 48°N, 163°E. As the 990-mb storm moved eastward, several ships calculated 16-ft waves to the south of the center. One of these was the AKAISHI MARU, south of Amchitka Island, with 35-kn winds and 16-ft swells. At 1200 on the 20th, the seas were 16 ft and the swells, 30 ft, from the east.

The front was now running well east of the LOW (49°N, 178°E), and the HIEI MARU and PLUVIUS both found gales ahead of the occlusion. Several frontal waves and minor LOWs had been moving around the outer circulation of the storm. These had the effect of alternately tightening and loosening the gradient, depending on the position. At 1200 on the 22d, the BREWSTER was about 400 mi south of the 1000-mb center, which was near Adak Island. She was battered by 55-kn following winds and 15-ft waves. The LOW disintegrated, on the 24th, under the pressure of two large HIGHs.

A LOW tracked out of Manchuria and headed northward over the Sea of Okhotsk on the 22d. It had deepened to about 978 mb, by late on the 24th, when it crossed into the East Siberian Sea. Southerly winds were blowing along the northwestern Alaskan coast. Late on the 25th, another LOW (983 mb) formed over the Chukotskiy Peninsula. The gradient over the Bering Sea and northwestern Alaska was now very tight, producing strong southerly to southwesterly winds.

As the new LOW moved northwestward off Point Barrow, on the 26th, its pressure dropped to 970 mb, with westerly winds over the Chukchi and Bering Seas. The geostrophic wind measured 70 kn, and there were reported winds as high as 60 kn. Three barges (fig. 21) went aground near Wainwright, Alaska. They were part of a flotilla of barges attempting to deliver

Figure 21.--Barges similar to this one were blown aground and damaged by the high winds and waves. Photo Courtesy of Helen L. Atkinson.

oilfield cargo to Prudhoe Bay. The barges had been delayed due to ice along the coast southwest of Point Barrow. All the barges were later refloated, with extensive damage to one reported. There was considerable flooding along the south coast of the Seward Peninsula and the coast in Norton Sound. The village of Teller had to be evacuated, and there was flooding of homes and basements in other coastal towns. Cape Lisburne had 56-kn winds, and a radar site recorded 65 kn.

The deep LOW moved rapidly, especially for one so far north, to near 78°N, 140°W, by 1200 on the 27th. Strong westerly winds were still blowing along Alaska's north coast, but slackened on the 28th.

Tropical Cyclones, Eastern Pacific--Georgette began as a tropical depression about 700 mi southwest of Cape San Lucas, late on August 10, with 25-kn winds, and headed westward at about 5 kn. Tropical storm intensity was reached 24 hr later, near 14.7°N, 120°W, when the course curved gently northwestward, and the speed increased to 8 to 10 kn. Maximum winds of 40 kn were indicated from 0600 on the 12th to 0000 on the 13th, when slow weakening began.

The track then curved westward again, with a forward speed of 10 to 12 kn, reaching 17.4°N, 125.3°W, at 0600 on the 13th, when the intensity dropped to the tropical depression stage. Further weakening continued, through 0600 on the 14th, and bulletins were discontinued.

No reporting vessels approached closer than 300 mi of the cyclone.

The gradual organization of a tropical disturbance, near 11°N, 103°W, was noticed in satellite pictures on August 11. A circulation had developed by 1800 on the 12th. It was moving west-northwestward at 8 to 10 kn, and tropical cyclone Nine had formed near 11.4°N, 107°W, with 30-kn winds in squalls and thunderstorms near the center.

The depression increased to tropical storm intensity and was named Hilary at 0600 on the 13th. Winds of 40 kn were estimated from satellite pictures, and the center, moving northwestward at 10 kn, was indicated near 12°N, 109.5°W. The northwesterly movement continued, and its forward speed increased to 14 kn, as winds near the center increased to 50 kn, at 0000 on the 15th, near 16.5°N, 116°W.

Weakening followed this northwesterly acceleration, with the center reaching 20.3°N, 121.7°W, at 1200 on the 16th, when the storm became a depression with 30-kn winds. The center then began curving west-northwestward as weakening continued. Dissipation was near 21°N, 124°W, at 1200 on the 17th.

Gale winds were reported by a vessel with 1007-mb pressure, about 100 mi northwest of the center, at 0000 on the 13th, while the cyclone was still classified as a depression. The GALILEO GALILEI, 150 mi south of the center, reported 15-kn winds at 0600 on the 13th. No other vessel reported within the circulation of the cyclone.

A disturbance that apparently crossed Central America between 8° and 13°N was followed west-northwestward from near 7°N, 83°W, beginning on the 16th. It was moving at about 20 kn, and a weak circulation was suggested by reports from the AMERICAN AQUARIUS and the DEVON CITY. Reports from the RIGOLETTO and DEVON CITY, at 1800, indicated it had moved to 9°N, 89°W, but the winds reported were only 5 to 10 kn. By 1200 on the 17th, the disturbance was indicated by satellite pictures to be near 12°N, 94°W, and the windspeeds had increased to 10 to 20 kn, at points 100 to 150 mi from the center of the shower and thunderstorm activity. Six hours later, the PORTMAR and the ELISABETH BOLTEN added their reports indicating further intensification.

By 0000 on the 18th, reports from the UNIQUE FORTUNE indicated that tropical depression Ten had formed, near 12.1°N, 95.8°W, and was moving west-northwestward at about 8 kn. By 1200 on the 18th, the depression had intensified to tropical storm Ilsa, near 12.3°N, 97°W. Movement continued west-northwestward at 8 to 10 kn, but a more westerly track was observed as intensification took place. The storm became a hurricane near 14°N, 104°W, at 0000 on the 21st, on a course of 280° at 9 kn.

Intensification continued, with winds reaching 85 to 95 kn, from 1200 on the 22d through 0600 on the 25th. Ship reports were few--a Chinese vessel reported 30- to 40-kn winds as she passed 200 mi south of the center on the 23d.

The track curved northwestward at 10 kn, from 1800 on the 22d through 1800 on the 24th, then westward again. Weakening began, at 0600 on the 25th, and was rapid. Ilsa became a tropical storm near 19.7°N, 126.1°W, at 0000 on the 26th, and a depression by 1800, near 20.3°N, 129.1°W.

The remnants of Ilsa were followed westward in satellite pictures and, with the aid of reports from the AVOCET, CHAO MING, HAWAIIAN MONARCH, MALLORY LYKES, MATSONIA, ORONSAY, PRINCE MARU No. 7, SHOZEN MARU, and the SILVEROON, to near 29°N, 153°W, by 1800 on the 31st, but no reports were for more than 25-kn winds.

Tropical storm appearance began again, on September 3, when VHRR (Very High Resolution Radiometer) pictures showed an intense circulation, complete with an eye, near 38°N, 158°W, with 35-kn winds reported by the HAGAOROMO MARU at 1800, 45-kn winds by the PLUVIUS, and 35-kn winds by the TRANSCOLORADO at 0000 on the 4th. At 0600 on the 4th, 55-kn winds were reported by the TRANSCOLORADO. The LOW then moved northeastward, through 0000 on the 6th, and dissipated in the eastern Gulf of Alaska.

The long period of hurricane winds--from 0000 on the 21st through 0000 on the 26th--and the regeneration to storm intensity north of Hawaii made Ilsa a unique storm. Such regeneration has never been so well documented in the eastern North Pacific area.

While Ilsa was churning her way northwestward 400 mi southwest of Cape San Lucas, a tropical disturbance formed about 300 mi south of Acapulco. Initial reports from the PRUD OCEANJET and the KRYPTOS indicated winds to 30 kn in squalls, at 1800 on the 23d, and suggested tropical depression Eleven had formed. The depression was moving west-northwestward at 12 kn, but slowed to about 5 kn, by 1800 on the 25th, and formed tropical storm Jewel.

The course changed to westerly at 5 to 8 kn, and intensification to a marginal hurricane took place by 1200 on the 27th. Slow weakening, and acceleration

west- and northwestward, continued through 0000 on the 31st, to tropical depression strength near 19°N, 126.2°W. Bulletins on the depression were discontinued after 1200 on the 31st, but remnants of the circulation were still visible in satellite pictures until September 3.

Tropical storm Jewel was working her way westward some 400 mi southwest of Cape San Lucas, and Ilsa was a tropical depression 1,000 mi east of Honolulu, at 1800 on the 28th, when a rapidly developing tropical depression formed 400 mi south of Acapulco. Successive satellite pictures of Katrina indicated a west-northwestward 10-kn movement, and hurricane intensity was forecast within 48 hr. Hurricane strength was reached even sooner, at 1800 on the 29th, near 11.5°N, 103.7°W.

The track became more northwesterly, and gradual intensification continued until 80-kn winds were indicated when the center was 150 mi southeast of Socorro Island, at 1200 on September 1, and 115-kn winds when the center was 180 mi northwest of Socorro Island, at 1200 September 3.

Weakening began, and the course became westerly following the peak intensity at 1200 September 3. The hurricane was downgraded to a tropical storm, at 1200 on the 5th, near 22°N, 121°W. Dissipation was almost as rapid as intensification, with tropical depression stage indicated by 1200 on the 6th. Bulletins were discontinued at 0000 on the 7th.

The lowest pressure reported near the center was at Socorro Island, at 0000 on the 2d, with a reading of 978 mb. This barometer reading appears to be 6 mb low when compared to vessels passing nearby, but an 85-kn wind was reported when Katrina was estimated to be only a few miles west of the island.

Few vessels encountered the hurricane or gale winds of Katrina. The DAPHNE reported 35-kn winds, 200 mi east-northeast of the center, at 0000 on the 3d.

Tropical Cyclones, Western Pacific -- Typhoon Ora developed near Taiwan. On the 10th, she was detected as a tropical storm about 200 mi east of southern Taiwan. Ora reached typhoon strength, the following day, as she headed northward into the East China Sea. Maximum sustained winds reached 70 kn, on the 11th, and the typhoon turned northwestward toward mainland China. On the 12th, Ora, at tropical storm strength, crossed the coast near Wen-chow.

Typhoons Phyllis and Rita brought death and destruction to Japan during one week in August. Both clobbered Shikoku and Honshu, while Rita caused the worst flooding in 10 yr on Hokkaido. At least 90 people died as a result of the two storms. The cover picture shows flood waters from Phyllis and figure 22 shows the destruction wrought by Rita.

Figure 22.--Rescue workers clear debris from flood waters and a damaged home while rain from Typhoon Rita is still falling. United Press International Photo.

On the 12th, Phyllis reached tropical storm strength, about 420 mi west of Guam. Moving northward, she developed rapidly. By the 13th, she was a typhoon, and, on the following day, maximum winds near her center were estimated at 115 kn. Gales extended out over 200 mi, as can be attested to by the NIPPO MARU, which encountered southerly 35-kn winds more than 200 mi east-southeast of the storm's center, early on the 15th. Winds of 100 kn or more continued near the center into the 16th, as Phyllis headed northwestward across the 30th parallel. Bearing 85-kn winds, the typhoon crossed southern Shikoku and Honshu, on the 17th, and continued into the Sea of Japan, where she slowly dissipated after heading northward along the 130th meridian. She left Shikoku reeling. Torrential rains caused flooding and devastating landslides. This resulted in an estimated 60 deaths on the small island. In addition, nearly 1,000 homes were destroyed or damaged.

While Phyllis was dying, Rita was coming to life a couple of hundred miles southeast of Okinawa, on the 18th. The tropical storm brushed the central Ryukyus, on the 20th, as she turned northeastward. The following day, Rita was a typhoon crossing the 30th parallel. Ocean Station Vessel TANGO felt the sting of 40-kn southeasterlies, sailing some 180 mi east-southeast of Rita's center, on the 21st. Winds near her center climbed to 85 kn before she brushed the eastern part of Shikoku and moved across the Kii Strait and over Osaka. Rita lost her typhoon strength overland and emerged a tropical storm in the Sea of Japan, south of Kanazawa. However, the storm recurved northeastward and recrossed Honshu in the north. She then moved along the coast of Hokkaido, generating torrential rains, which totaled over 8 in over a large area. This resulted in extensive flooding along the Ishikari River. Along with landslides, this resulted in eight deaths on Hokkaido.

On Shikoku, 15-ft waves pounded the beach at Tosa, while Cape Muroto registered peak gusts of 66 kn. Rainfall up to 9 in was measured on Shikoku, while the Kii Peninsula was pelted with 4 to 6 in of rain and gale-force winds. Gusts of 63 kn were recorded at Osaka, and 55 kn, at Tokyo. In the mountains of Honshu, up to 26 in of rain were reported.

Susan started her career late in the month and far out to sea. She formed near Marcus Island on the 24th. Remaining a tropical depression, she headed northward. She petered out, on the 27th, but reformed near 35°N, 153°E, on the 29th. As a tropical storm, she moved eastward, then northward, for a couple of days before becoming extratropical.

Casualties--The 1,597-ton South Korean freighter SUN STAR sank in rough seas resulting from typhoon Nina, off Taiwan's southwest coast, on the 3d. Thirteen crewmembers were rescued, one was killed, and nine were missing. The Panamanian WINSON (23,199 tons), which went aground in January at 11.5°N, 114.4°E, sank in heavy seas after being refloated.

The Panamanian ARIES ran aground and caught fire, near Salina Cruz, Mexico. During the nights of the 17th and 18th, the vessel swung broadside to the beach and was pounded by heavy swells.

THE MARINERS WEATHER LOG WELCOMES ARTICLES AND LETTERS FROM MARINERS RELATING TO METEOROLOGY AND OCEANOGRAPHY, INCLUDING THEIR EFFECTS ON SHIP OPERATIONS.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

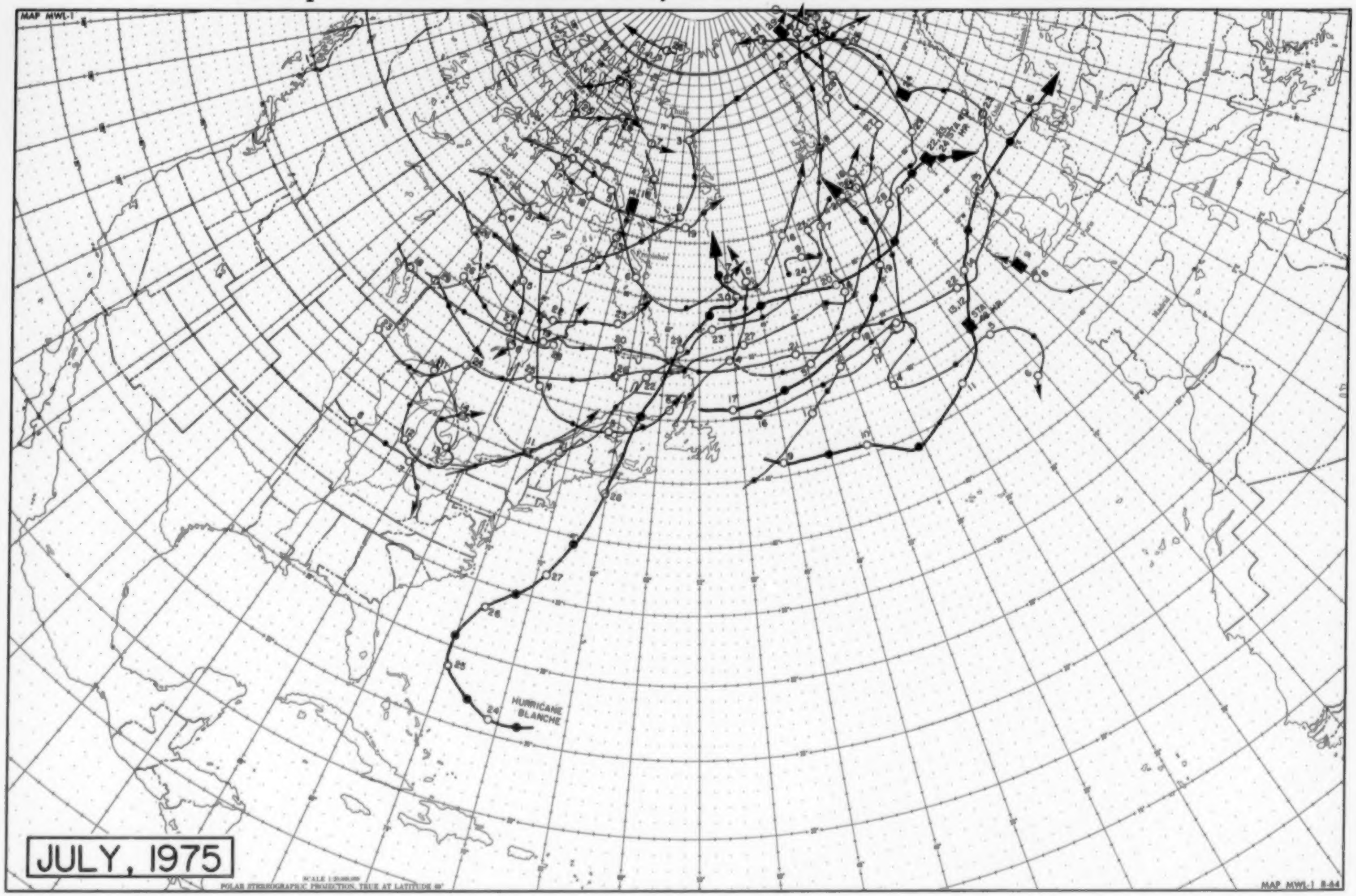

Figure 23. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

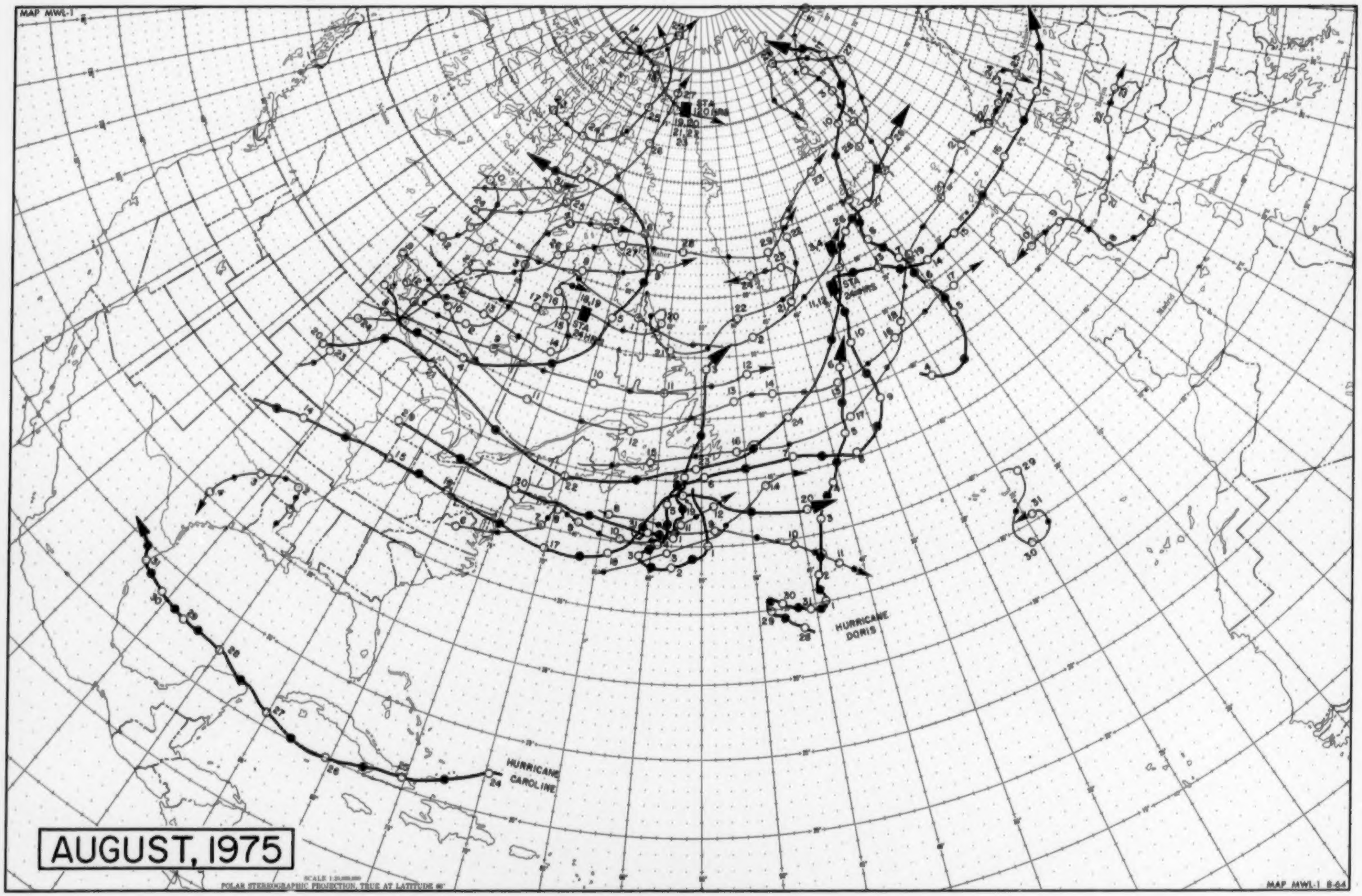

Figure 24. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

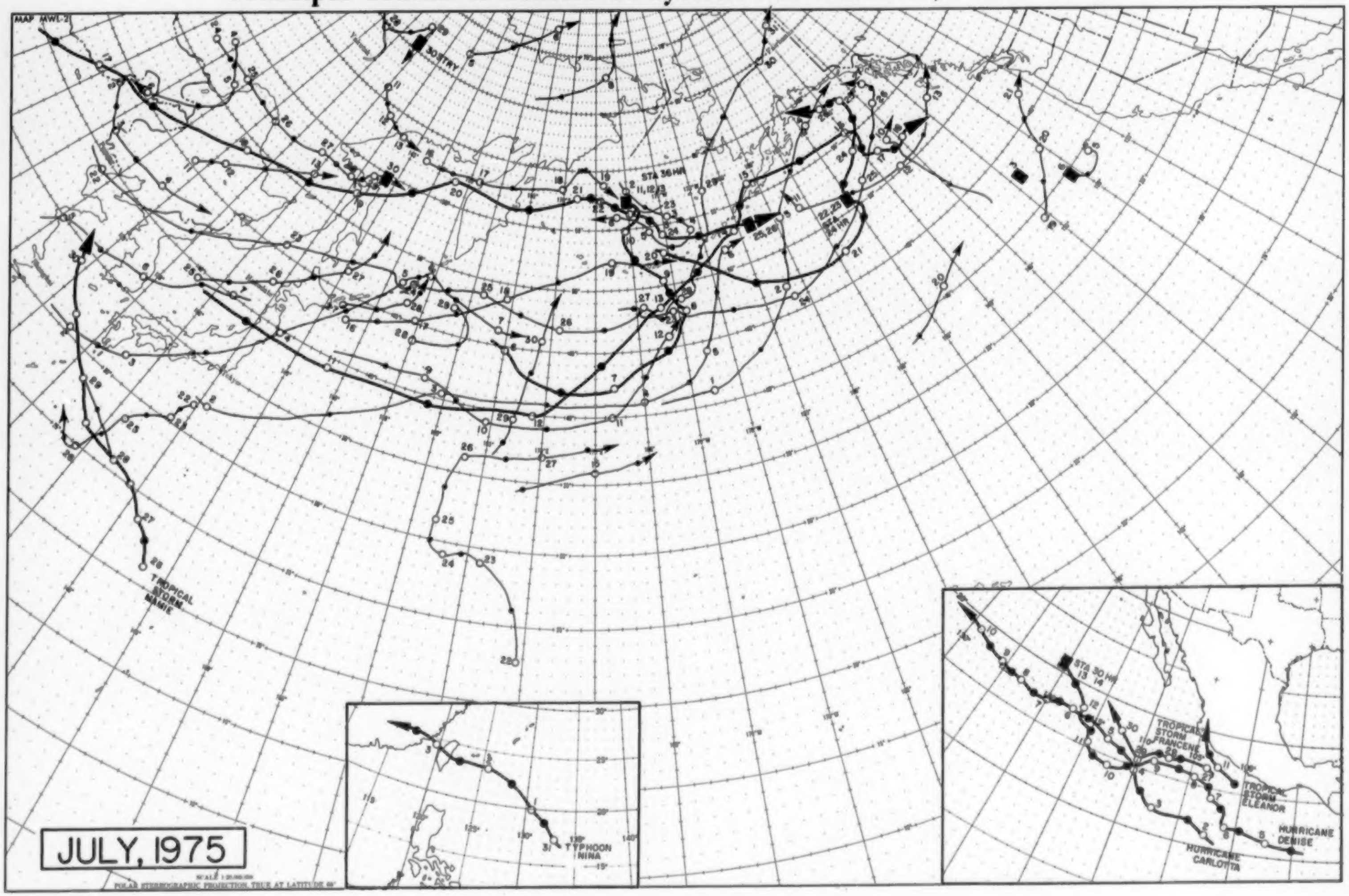

Figure 25. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

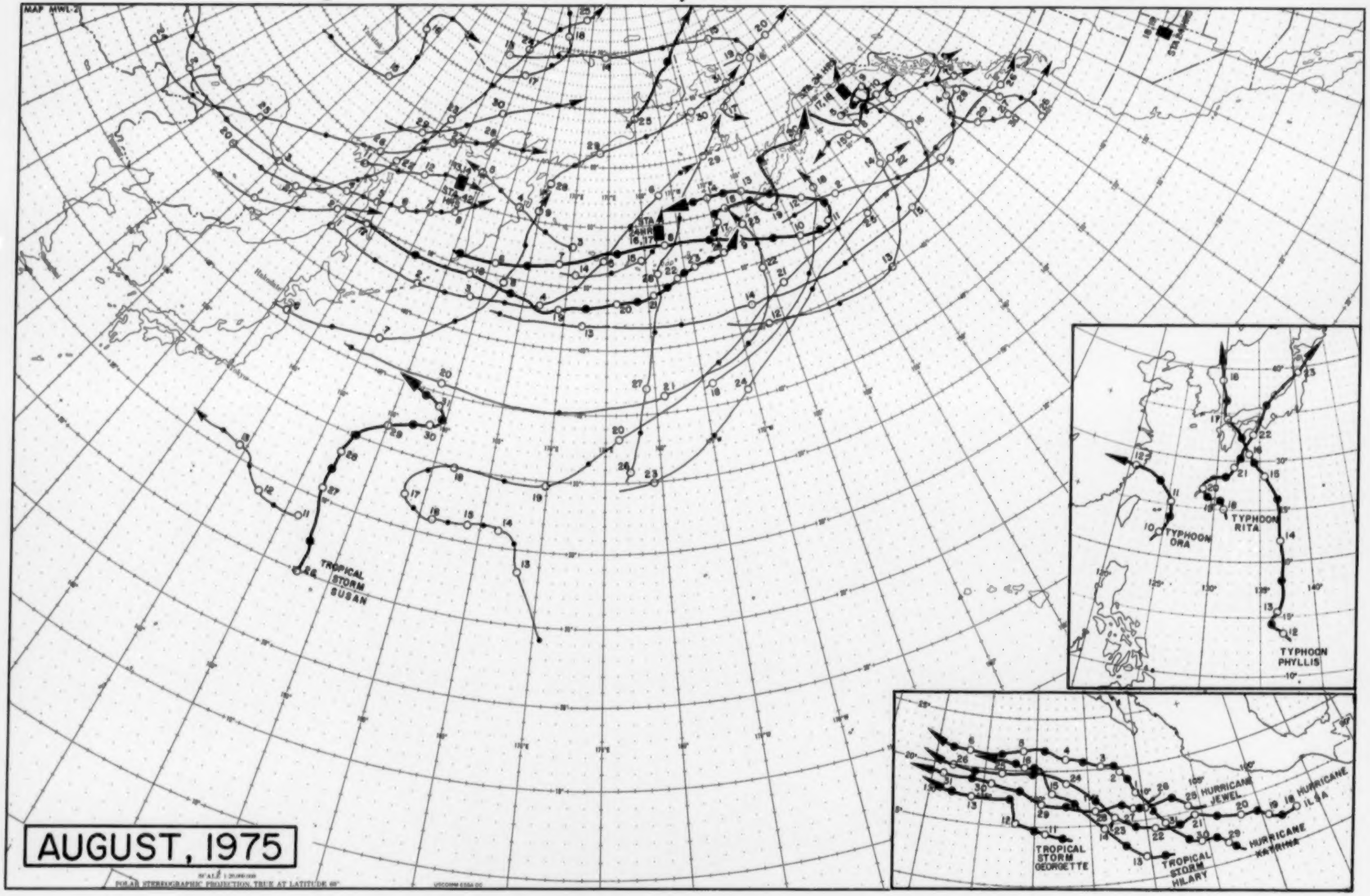

Figure 26. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Table 7
U.S. Ocean Weather Station Climatological Data, North Atlantic

Ocean Weather Station 'HOTEL' 38°00'N 71°00'W **July and August, 1975**

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	DEW-POINT TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	SEA TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	AIR-SEA TEMP DIFFERENCE (°C) MIN	DA HR	MEAN	MAX	DA HR
JULY	DATA NOT AVAILABLE																			
AUG	20.9	31 18	24.8	29.0	28 18	12.4	24 09	21.1	26.1	04 21	22.8	17 18	25.5	28.1	*31 12	- 6.9	31 12	- .6	3.9	17 18

MONTH	MEANS AND EXTREMES PRESSURE (MB) MIN	DA HR	MEAN	MAX	DA HR	PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS) TOTAL CLOUD 0-2	3-5	6-7	8 & OBSC	LOW CLOUD 0-2	3-5	6-7	8 & OBSC	DAYS WITH SPECIFIED WEATHER RAIN OR DRZL PCPN	SNOW	TSTM	VSBY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	%OBS WITH PCPN	NO OF OBS
JULY	DATA NOT AVAILABLE																						
AUG	1010.5	07 09	1017.7	1024.3	21 15	28.5	27.7	33.1	10.7	77.3	15.7	5.4	1.7	9 8	1	2	1	1	0	0	27	2.5	242

** VV-90-93 AND/OR W=4 · COMP OB DAYS=COMPLETE OB DAYS

Wind

JULY WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	DATA NOT AVAILABLE							
NE								
E								
SE								
S								
SW								
W								
NW								
CALM								
TOTAL								

NUMBER OF OBS; MAX WIND DIR SPEED DA HR; VECTOR SPEED; MEAN DIR (DIR IN DEGREES)

AUG WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	4.6	5.6	.0	.0	.0	10.2	10.6
NE	.0	4.5	4.6	.0	.0	.0	9.2	11.2
E	.4	3.4	1.9	.0	.0	.0	5.7	8.9
SE	.1	.5	1.5	.0	.0	.0	2.2	10.6
S	.7	4.2	2.3	.0	.0	.0	7.2	8.3
SW	.8	7.6	8.4	.0	.0	.0	16.8	10.8
W	.4	10.7	16.9	.7	.0	.0	28.8	11.5
NW	.4	8.0	6.8	.1	.0	.0	15.3	10.8
CALM	4.5	.0	.0	.0	.0	.0	4.5	.0
TOTAL	7.4	41.7	50.0	.8	.0	.0	100.0	10.2

NUMBER OF OBS	MAX WIND DIR	SPEED	DA HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
242	320	35	05 1010	4.7	281	

Wave

JULY WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	DATA NOT AVAILABLE								
NE									
E									
SE									
S									
SW									
W									
NW									
IND									
CALM									
TOTAL									

NUMBER OF OBS IND=INDETERMINATE

AUG WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	2.1	12.2	.3	.0	.0	.0	.0	.0	14.6
NE	2.1	6.9	1.8	.0	.0	.0	.0	.0	10.7
E	.0	4.9	.0	.0	.0	.0	.0	.0	4.9
SE	.0	3.1	.0	.0	.0	.0	.0	.0	3.1
S	1.0	7.0	.0	.0	.0	.0	.0	.0	8.1
SW	.6	15.8	.6	.0	.0	.0	.0	.0	17.0
W	.7	17.0	4.3	.0	.0	.0	.0	.0	22.1
NW	.5	8.3	1.2	.0	.0	.0	.0	.0	10.0
IND	1.7	7.9	.0	.0	.0	.0	.0	.0	9.5
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	8.7	83.1	8.3	.0	.0	.0	.0	.0	100.0

NUMBER OF OBS 242 IND=INDETERMINATE

JULY WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	DATA NOT AVAILABLE								
6-7									
8-9									
10-11									
12-13									
>13									
IND									
TOTAL									

NUMBER OF OBS; MAX WAVE HEIGHT HGT PER DIR TYPE DA HR; IND=INDETERMINATE (DIR IN DEGREES)

AUG WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	6.6	40.9	2.1	.0	.0	.0	.0	.0	49.6
6-7	.4	29.8	6.2	.0	.0	.0	.0	.0	36.4
8-9	.0	3.7	.0	.0	.0	.0	.0	.0	3.7
10-11	.0	.8	.0	.0	.0	.0	.0	.0	.8
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	1.7	7.9	.0	.0	.0	.0	.0	.0	9.5
TOTAL	8.7	83.1	8.3	.0	.0	.0	.0	.0	100.0

NUMBER OF OBS	MAX WAVE HEIGHT HGT	PER	DIR	TYPE	DA HR
242	2.5	6	030	SEA	31 18

IND=INDETERMINATE (DIR IN DEGREES)

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

Table 8
U.S. Ocean Buoy Climatological Data
July and August 1975

JULY — D A T A S U M M A R Y — E803

AVERAGE LATITUDE 56.0N — AVERAGE LONGITUDE 147.9W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	05.0	(06 15)	09.9	12.4	(10 03)	236	31
DEWPOINT TEMP (DEG C)	04.3	(02 12)	08.1	10.1	(19 12)	232	31
PRESSURE (MBAR)	0993.4	(24 12)	1013.2	1034.1	(06 00)	244	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 242

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.7	5.4	.4				7.4	5.5
NE	2.5	2.9	2.1				7.4	7.7
E	2.1	7.4	5.0	2.5			16.9	11.9
SE	3.3	11.2	2.9				17.4	7.1
S	2.5	4.5	.8				7.9	5.5
SW	1.7	2.1	2.1				5.8	8.3
W	2.1	8.7	11.2				21.9	11.0
NW	1.2	11.2	1.7				14.0	7.2
CALM	1.2						1.2	.0
TOTAL	18.2	53.3	26.0	2.5			100.0	8.6

MAX WIND — SPEED: 28 KNOTS — DIRECTION: 070 DEG — DAY: 23 — HOUR: 09

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 235

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	3.0	68.3	21.7	5.1	1.7				1.6M	4.5M (23 03)

PRECIPITATION
NO. OF DAYS WITH PRECIP: 8 NO. OF DAYS WITH REPORTS/ COMPLETE: 29 PARTIAL: 2
NO. OF OBS WITH PAST OR PRESENT PRECIP: 17 NO. OF WEATHER OBS: 246

AUGUST — D A T A S U M M A R Y — E803

AVERAGE LATITUDE 56.0N — AVERAGE LONGITUDE 147.9W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	07.8	(02 06)	10.6	14.1	(07 00)	247	31
DEWPOINT TEMP (DEG C)	06.2	(13 21)	09.5	11.0	(30 21)	247	31
PRESSURE (MBAR)	1000.8	(06 00)	1013.4	1024.3	(03 12)	248	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 247

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.2	5.3	2.8	.4			9.7	9.5
NE		2.8	.4				3.2	7.8
E	.4	8.1	4.9	.4			13.8	10.5
SE		5.3	4.9				10.1	11.0
S	1.6	3.2	1.2				6.1	6.5
SW	1.2	4.0	1.6				6.9	7.9
W	.8	10.1	6.1				17.0	9.6
NW	2.0	11.7	17.8	1.2			32.8	11.3
CALM	.4						.4	.0
TOTAL	7.7	50.6	39.7	2.0			100.0	10.0

MAX WIND — SPEED: 26 KNOTS — DIRECTION: 330 DEG — DAY: 27 — HOUR: 21

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 245

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	1.6	78.8	17.1	1.2	.8	.4			1.4M	6.3M (27 21)

PRECIPITATION
NO. OF DAYS WITH PRECIP: 13 NO. OF DAYS WITH REPORTS/ COMPLETE: 31 PARTIAL: 0
NO. OF OBS WITH PAST OR PRESENT PRECIP: 24 NO. OF WEATHER OBS: 248

JULY — D A T A S U M M A R Y — E810

AVERAGE LATITUDE 27.5N — AVERAGE LONGITUDE 088.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	23.5	(14 00)	27.7	31.2	(04 21)	170	22
DEWPOINT TEMP (DEG C)	20.4	(05 00)	23.0	24.6	(11 18)	171	22
SEA TEMP (DEG C)	28.1	(14 15)	29.1	30.3	(01 00)	171	22
AIR-SEA TEMP (DEG C)	-05.1	(12 18)	-01.3	01.3	(17 18)	170	22
PRESSURE (MBAR)	1011.4	(12 21)	1016.3	1020.7	(03 15)	171	22

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 170

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		1.8					1.8	7.7
NE	1.2	5.9	.6				7.6	5.7
E	1.2	12.4	5.9				19.4	8.3
SE	1.8	11.8	1.2				14.7	6.9
S	3.5	10.0	1.2				14.7	5.9
SW		7.1	8.2	.6			15.9	11.3
W	1.2	10.0	8.8	.6			20.6	10.4
NW		2.4	2.4				4.7	9.8
CALM	.6						.6	.0
TOTAL	9.4	61.2	28.2	1.2			100.0	8.5

MAX WIND — SPEED: 26 KNOTS — DIRECTION: 260 DEG — DAY: 12 — HOUR: 12

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 21

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	81.0	19.0							.6M	1.0M (26 06)

PRECIPITATION
NO. OF DAYS WITH PRECIP: 7 NO. OF DAYS WITH REPORTS/ COMPLETE: 17 PARTIAL: 4
NO. OF OBS WITH PAST OR PRESENT PRECIP: 11 NO. OF WEATHER OBS: 171

AUGUST — D A T A S U M M A R Y — E810

AVERAGE LATITUDE 27.5N — AVERAGE LONGITUDE 088.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	26.0	(22 18)	28.5	32.0	(17 21)	99	14
DEWPOINT TEMP (DEG C)	22.6	(22 03)	24.0	26.1	(24 06)	98	14
SEA TEMP (DEG C)	28.8	(15 12)	29.4	30.8	(19 21)	97	14
AIR-SEA TEMP (DEG C)	-03.9	(21 18)	-01.0	02.3	(17 18)	97	14
PRESSURE (MBAR)	1015.2	(26 00)	1018.0	1020.5	(23 18)	98	14

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 98

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		1.0					1.0	7.0
NE	3.1	15.3					18.4	5.4
E	2.0	27.6	18.4				48.0	9.3
SE	1.0	12.2	5.1				18.4	9.1
S	2.0	5.1					7.1	5.0
SW	2.0	1.0					3.1	2.3
W	1.0						1.0	1.0
NW	1.0						1.0	1.0
CALM	2.0						2.0	.0
TOTAL	14.3	62.2	23.5				100.0	7.6

MAX WIND — SPEED: 20 KNOTS — DIRECTION: 110 DEG — DAY: 22 — HOUR: 15

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 91

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	68.1	31.9							.6M	1.5M (22 15)

PRECIPITATION
NO. OF DAYS WITH PRECIP: 1 NO. OF DAYS WITH REPORTS/ COMPLETE: 11 PARTIAL: 3
NO. OF OBS WITH PAST OR PRESENT PRECIP: 2 NO. OF WEATHER OBS: 99

JULY — D A T A S U M M A R Y — E816

AVERAGE LATITUDE 42.5N — AVERAGE LONGITUDE 130.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	13.2	(30 06)	15.4	17.3	(23 03)	117	15
SEA TEMP (DEG C)	13.8	(17 15)	16.8	18.0	(28 00)	116	15
AIR-SEA TEMP (DEG C)	-03.4	(30 06)	-01.4	00.7	(23 03)	115	15
PRESSURE (MBAR)	1012.1	(18 03)	1020.7	1030.7	(31 21)	118	15

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 116

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.7	9.5	22.4	7.8			41.4	14.3
NE	.9	1.7					2.6	3.7
E	.9	.9					1.7	3.6
SE			.9				.9	13.0
S	1.7	5.2	2.6				9.5	8.0
SW		6.9	3.4				10.3	9.6
W		5.2	6.9				12.1	10.7
NW	.9	6.0	14.7				21.6	11.5
CALM								
TOTAL	6.0	35.3	50.9	7.8			100.0	11.7

MAX WIND — SPEED: 25 KNOTS — DIRECTION: 330 DEG — DAY: 20 — HOUR: 15

AUGUST — D A T A S U M M A R Y — E816

AVERAGE LATITUDE 42.5N — AVERAGE LONGITUDE 130.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	14.0	(23 18)	15.9	17.7	(16 00)	246	31
SEA TEMP (DEG C)	14.6	(28 15)	16.6	17.5	(16 06)	246	31
AIR-SEA TEMP (DEG C)	-03.[illegible]	(21 15)	-01.9	00.6	(16 00)	244	31
PRESSURE (MBAR)	100[illegible]	(27 03)	1022.5	1029.9	(01 06)	246	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 247

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		5.3	41.7	1.2			48.2	14.7
NE		.4	.4				.8	12.0
E	.4						.4	3.0
SE								
S	.4		.4				.8	8.6
SW		1.6	2.8				4.4	12.3
W	.4	2.8	19.8				23.1	14.1
NW		6.5	15.0	.8			22.3	12.4
CALM								
TOTAL	1.2	16.6	80.2	2.0			100.0	13.8

MAX WIND — SPEED: 25 KNOTS — DIRECTION: 360 DEG — DAY: 21 — HOUR: 15

JULY — D A T A S U M M A R Y — E833

AVERAGE LATITUDE 58.9N — AVERAGE LONGITUDE 141.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	09.6	(31 21)	11.0	12.6	(23 15)	88	14
SEA TEMP (DEG C)	10.6	(31 21)	11.6	12.9	(27 00)	88	14
AIR-SEA TEMP (DEG C)	-01.6	(29 21)	-00.6	01.1	(23 15)	85	14
PRESSURE (MBAR)	1001.3	(25 00)	1010.7	1017.6	(22 09)	88	14

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 88

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.1	1.1	1.1				3.4	6.7
NE	1.1	9.1	2.3				12.5	7.4
E	1.1	8.0	27.3	2.3			38.6	14.1
SE	1.1	10.2	5.7				17.0	9.0
S		10.2	1.1				11.4	7.5
SW	1.1	9.1	3.4				13.6	8.9
W		2.3					2.3	4.5
NW	1.1						1.1	2.0
CALM								
TOTAL	6.8	50.0	40.9	2.3			100.0	10.3

MAX WIND — SPEED: 23 KNOTS — DIRECTION: 090 DEG — DAY: 24 — HOUR: 15

AUGUST — D A T A S U M M A R Y — E833

AVERAGE LATITUDE 58.3N — AVERAGE LONGITUDE 141.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	09.0	(01 06)	11.9	13.7	(30 00)	211	31
SEA TEMP (DEG C)	10.8	(01 12)	12.1	13.7	(30 00)	207	31
AIR-SEA TEMP (DEG C)	-02.3	(30 15)	-00.4	00.6	(29 00)	207	31
PRESSURE (MBAR)	0995.4	(27 21)	1012.8	1022.3	(13 09)	210	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 207

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.4	1.9	.5				3.9	5.8
NE	1.9	4.3	3.9				10.1	8.0
E	1.4	4.8	26.1	1.9			34.3	14.3
SE	.5	3.9	3.9				8.2	10.6
S	1.0	3.9	.5				5.3	6.5
SW	1.4	3.9	1.9				7.2	8.2
W	2.9	9.7	6.8				19.3	8.4
NW	1.4	5.8	4.3				11.6	8.3
CALM								
TOTAL	12.1	38.2	47.8	1.9			100.0	10.4

MAX WIND — SPEED: 23 KNOTS — DIRECTION: 090 DEG — DAY: 17 — HOUR: 18

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AUGUST                       D A T A     S U M M A R Y                              E804
          AVERAGE LATITUDE  26.0N                     AVERAGE LONGITUDE  090.0W
------------------------------------------------------------------------------------------
MEANS AND EXTREMES                           |         |                     | NO. OF | DAYS WITH
                              MIN    (DA HR) |   MEAN  |   MAX    (DA HR)    |  OBS   |   DATA
     AIR  TEMP (DEG C)  25.6   (23 15) |   29.0  |   31.6   (17 18)    |   81   |    11
DEWPOINT  TEMP (DEG C)  19.9   (22 12) |   23.6  |   24.8   (18 03)    |   80   |    11
     SEA  TEMP (DEG C)  28.8   (15 12) |   29.5  |   30.5   (14 21)    |   76   |    11
 AIR-SEA  TEMP (DEG C) -03.7   (23 15) |  -00.5  |   01.8   (17 18)    |   76   |    11
    PRESSURE  (MBAR) 1015.9   (19 00) | 1017.7  | 1020.3   (23 15)    |   81   |    11
------------------------------------------------------------------------------------------
WIND - % FREQUENCIES, MEANS AND EXTREMES
        |------- SPEED   (KNOTS)-------------|-------| MEAN
    ----|          4-    11-    22-    34-   | TOTAL | SPEED     NO. OF OBS:    80
    DIR |   <4     10     21     33     47  >47 |   %   |(KNOTS)
    ----|                                    |       |
    N   |                                    |       |              MAX WIND
    NE  |  2.5   13.8    1.3                 |  17.4 |  3.9     SPEED:  16 KNOTS
    E   |  2.5   28.8   17.5                 |  48.8 |  9.0     DIRECTION: 080 DEG
    SE  |  2.5   21.3    1.3                 |  25.0 |  7.8     DAY:    22
    S   |  2.5    2.5    1.3                 |   6.3 |  6.4     HOUR:   00
    SW  |                                    |       |
    W   |  1.3                               |   1.3 |  2.0
    NW  |  1.3                               |   1.3 |  1.0
  CALM  |                                    |       |
  TOTAL | 12.5   66.3   21.3                 | 100.0 |  7.8
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AUGUST                       D A T A     S U M M A R Y                              E832
          AVERAGE LATITUDE  38.3N                     AVERAGE LONGITUDE  074.3W
------------------------------------------------------------------------------------------
MEANS AND EXTREMES                           |         |                     | NO. OF | DAYS WITH
                              MIN    (DA HR) |   MEAN  |   MAX    (DA HR)    |  OBS   |   DATA
     AIR  TEMP (DEG C)  19.2   (31 12) |   23.9  |   26.1   (26 18)    |   70   |    22
     SEA  TEMP (DEG C)  24.2   (10 12) |   25.3  |   26.1   (20 00)    |   70   |    22
 AIR-SEA  TEMP (DEG C) -05.7   (31 12) |  -01.5  |   00.1   (23 00)    |   69   |    22
    PRESSURE  (MBAR) 1012.9   (12 00) | 1018.0  | 1028.7   (23 12)    |   69   |    22
------------------------------------------------------------------------------------------
WIND - % FREQUENCIES, MEANS AND EXTREMES
        |------- SPEED   (KNOTS)-------------|-------| MEAN
    ----|          4-    11-    22-    34-   | TOTAL | SPEED     NO. OF OBS:    68
    DIR |   <4     10     21     33     47  >47 |   %   |(KNOTS)
    ----|                                    |       |
    N   |  1.5    4.4    1.5                 |   7.4 |  7.8         MAX WIND
    NE  |  1.5    5.9    1.5                 |   8.8 |  8.8     SPEED:  20 KNOTS
    E   |         5.9    5.9                 |  11.8 | 11.8     DIRECTION: 070 DEG
    SE  |  1.5                               |   1.5 |  3.0     DAY:    31
    S   |         5.9    4.4                 |  10.3 |  8.3     HOUR:   06
    SW  |  1.5   10.3    8.8                 |  20.6 |  9.6
    W   |  1.5   19.1   10.3                 |  30.9 |  9.4
    NW  |         8.8                        |   8.8 |  6.7
  CALM  |                                    |       |
  TOTAL |  7.4   60.3   32.4                 | 100.0 |  9.1
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AUGUST                       D A T A     S U M M A R Y                              E819
          AVERAGE LATITUDE  32.3N                     AVERAGE LONGITUDE  075.2W
------------------------------------------------------------------------------------------
MEANS AND EXTREMES                           |         |                     | NO. OF | DAYS WITH
                              MIN    (DA HR) |   MEAN  |   MAX    (DA HR)    |  OBS   |   DATA
     AIR  TEMP (DEG C)  23.2   (12 12) |   27.7  |   32.7   (24 21)    |  234   |    31
DEWPOINT  TEMP (DEG C)  22.6   (15 03) |   25.7  |   28.0   (23 21)    |  233   |    31
     SEA  TEMP (DEG C)  26.2   (22 00) |   27.6  |   23.8   (27 18)    |  197   |    31
 AIR-SEA  TEMP (DEG C) -03.9   (12 12) |   00.0  |   03.1   (09 21)    |  195   |    31
    PRESSURE  (MBAR) 1015.0   (31 21) | 1019.7  | 1024.6   (22 03)    |  238   |    31
------------------------------------------------------------------------------------------
WIND - % FREQUENCIES, MEANS AND EXTREMES
        |------- SPEED   (KNOTS)-------------|-------| MEAN
    ----|          4-    11-    22-    34-   | TOTAL | SPEED     NO. OF OBS:   234
    DIR |   <4     10     21     33     47  >47 |   %   |(KNOTS)
    ----|                                    |       |
    N   |   .5    3.0                        |   3.4 |  3.6
    NE  |   .4    2.6    3.8                 |   6.8 | 11.8         MAX WIND
    E   |   .9     .4    2.1                 |   3.4 | 11.2     SPEED:  28 KNOTS
    SE  |  2.1     .9     .4                 |   3.4 |  4.3     DIRECTION: 260 DEG
    S   |  2.1    6.4     .9                 |   9.4 |  6.3     DAY:    11
    SW  |  5.6   12.4   15.4     .4          |  33.8 |  9.3     HOUR:   18
    W   |  3.4   13.2   10.7     .4          |  27.8 |  9.8
    NW  |  1.3    7.7    2.1                 |  11.1 |  6.8
  CALM  |   .4                               |    .4 |   .0
  TOTAL | 17.1   46.6   35.5     .9          | 100.0 |  8.8
------------------------------------------------------------------------------------------
WAVES - % FREQUENCIES, MEAN AND EXTREME  (METERS)            NO. OF WAVE  OBS:      1
HEIGHT  (M)  <1   1-1.5 2-2.5 3-3.5 4-5.5 6-7.5 8-9.5  >9.5 | MEAN    MAX  (DA HR)
% FREQUENCY 100.0                                            |  .3M    .3M (01 21)
------------------------------------------------------------------------------------------
PRECIPITATION
NO. OF DAYS WITH PRECIP:   9   NO. OF DAYS WITH REPORTS/ COMPLETE:  29 PARTIAL:   1
NO. OF OBS WITH PAST OR PRESENT PRECIP:   17            NO. OF WEATHER OBS:   239
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Table 9
Selected Gale And Wave Observations, North Atlantic
July and August 1975

Vessel	Nationality	Date	Position of Ship: Lat. deg.	Position of Ship: Long. deg.	Time GMT	Wind: Dir. 10°	Wind: Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C: Air	Temperature °C: Sea	Sea Waves+: Period sec.	Sea Waves+: Height ft.	Swell Waves: Dir. 10°	Swell Waves: Period sec.*	Swell Waves: Height ft.
NORTH ATLANTIC		JULY															
STAGHOUND	AMERICAN	1	36.3 N	68.3 W	21	36	40 (A)	2 NM		1003.0	21.5	22.8	6	23	36	9	32.5
JOHN TYLER	AMERICAN	1	35.9 N	66.8 W	00	16	36 (A)	10 NM	01	1009.1	24.4	23.3	5	11.5	18	8	24.5
FORTALEZA	AMERICAN	1	20.8 N	34.3 W	18	07	M 35	10 NM	02	1018.0	24.0	22.5	4	5			
EXPORT DEMOCRACY	AMERICAN	1	39.3 N	63.9 W	06	03	40 (A)	5 NM	21	1011.2	20.0	25.8	3	14.5	06	6	10
EXXON BANGOR	AMERICAN	1	35.3 N	75.1 W	00	36	M 35 (A)	5 NM	01	1017.0	22.0	24.4	5	8	04	6	8
DALLAS	AMERICAN	1	37.6 N	73.9 W	00	36	38 (A)	5 NM	07	1017.0	18.5	26.1	9	10	05	11	13
STAGHOUND	AMERICAN	2	36.4 N	67.8 W	00	05	45 (A)	2 NM	60	1001.9	26.1	23.9	6	19.5	36	9	32.5
JOHN TYLER	AMERICAN	2	37.6 N	57.5 W	00	20	22 (A)	5 NM	02	1016.9	23.9	24.5	5	10	18	7	24.5
EXPORT DEMOCRACY	AMERICAN	2	39.5 N	71.8 W	00	04	38 (A)	10 NM	01	1016.6	17.3	17.3	2	11.5	05	< 6	14.5
ORE SATURN	LIBERIAN	2	33.3 N	14.6 W	18	05	35	10 NM	03	1013.0	20.2	20.6	5	10	05	6	14.5
DELAWARE SUN	AMERICAN	2	36.5 N	73.9 W	12	35	35 (A)	5 NM	03	1022.0	22.0	27.6	7	11.5			
SAN JUAN	AMERICAN	3	39.1 N	32.2 W	18	20	35 (A)	5 NM	02	1016.3	24.4	19.4	5	8			
STAGHOUND	AMERICAN	3	38.3 N	53.1 W	18	16	30 (A)	5 NM	16	1016.2	23.9	23.9	4	18	18	10	24.5
ORE SATURN	LIBERIAN	3	33.8 N	12.4 W	06	02	40	10 NM	14	1014.5	19.1	20.6	5	10	02	6	14.5
STAGHOUND	AMERICAN	4	40.1 N	46.2 W	12	20	18 (A)	2 NM		1023.8	23.9	21.4	3	11.5	18	7	24.5
EXPORT PATRIOT	AMERICAN	9	39.8 N	57.3 W	00	22	35	5 NM	01	1015.5	25.6	25.0	3	5	23	6	8
PACIFIC	SWEDISH	17	12.2 N	76.2 W	18	07	37	10 NM	02	1011.0	27.6	29.8	5	6.5			
HOEGH MIRANDA	NORWEGIAN	19	53.7 N	28.7 W	12	32	35	5 NM	02	1000.0	10.5		6	8			
AMER LEGEND	AMERICAN	23	48.9 N	10.5 W	00	28	35	10 NM	02	1011.2	17.0	17.8	5	16.5			
BIBB	AMERICAN	28	40.0 N	67.8 W	03	35	M 56 (B)	200 YD	07	992.5	23.2	24.7			19	8	19.5
NORTH ATLANTIC		AUG.															
DELTA BRASIL	AMERICAN	4	17.1 N	87.3 W	06	07	35	10 NM	02	1012.5	27.2	29.4	2	6.5	07	7	8
ZIM HONGKONG	LIBERIAN	4	43.0 N	60.0 W	18	01	35	5 NM	02	1008.2	18.0	18.8	4	6.5	36	6	10
AMER RANGER	AMERICAN	5	45.7 N	20.4 W	06	27	40	10 NM	02	1003.1	17.8	18.9	5	10	27	< 6	16.5
ANDREAS U	NORWEGIAN	5	46.7 N	14.0 W	12	20	35	5 NM	50	1004.0	20.0	19.5	7	11.5			
AMER ARCHER	AMERICAN	5	49.7 N	19.2 W	12	25	65	1 NM	64	997.9	12.3	15.7			25	8	19.5
AMER ACE	AMERICAN	6	49.8 N	13.4 W	18	22	35	10 NM	01	1009.3	16.7	17.8	5	10			
SEALAND RESOURCE	AMERICAN	19	50.9 N	20.2 W	12	25	40	5 NM	03	1005.0	16.5	15.0	3	8	25	< 6	19.5
SEALAND RESOURCE	AMERICAN	20	49.6 N	40.2 W	12	18	35	5 NM	02	1019.5	18.5	17.3	4	8	18	< 6	14.5
AMER RANGER	AMERICAN	20	47.7 N	38.5 W	18	16	35	10 NM	02	1018.3	20.0	20.8	5	13			
OLGA MAERSK	DANISH	24	44.5 N	38.0 W	18	24	35	5 NM	02	1012.0	20.0	18.8	7	16.5	25	9	24.5
EXPORT BUILDER	AMERICAN	24	38.4 N	46.4 W	00	25	35	10 NM	13	1012.2	26.7	25.8	5	6.5	25	7	14.5
AMER LEGEND	AMERICAN	24	43.6 N	45.8 W	06	25	45	5 NM	02	1000.3	17.0	21.8	4	10			
AMERICA SUN	AMERICAN	31	33.8 N	43.4 W	18	18	35	10 NM	16	1003.0	27.7	23.8	5	6.5	24	6	8
GREAT LAKES VESSELS																	
ERNEST R BREECH	AMERICAN	9	46.7 N	85.8 W	06	21	M 35	10 NM	02		18.0	17.8	XX	5			
BENJAMIN F FAIRLESS	AMERICAN	13	45.5 N	86.3 W	06	24	M 50	200 YD	18		16.0	15.0	2	6.5			
ELTON HOYT II	AMERICAN	24	43.8 N	86.7 W	12	24	M 37	1 NM	97		21.0	20.8	5	5			
EDMUND FITZGERALD	AMERICAN	31	45.8 N	83.8 W	12	09	M 40	10 NM	03		17.0	16.0		5			

+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind
(A) Tropical storm Amy
(B) Hurricane Blanche

NOTE: The observations are selected from those with winds ≥ 35 kt or waves ≥ 25 ft from May through August (≥ 41 kt or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest wind speed was selected.

Table 10

Selected Gale and Wave Observations, North Pacific

July and August 1975

Vessel	Nationality	Date	Position of Ship: Lat. deg.	Position of Ship: Long. deg.	Time GMT	Wind: Dir. 10°	Wind: Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C: Air	Temperature °C: Sea	Sea Waves†: Period sec.	Sea Waves†: Height ft.	Swell Waves: Dir. 10°	Swell Waves: Period sec.*	Swell Waves: Height ft.
NORTH PACIFIC		JULY															
MANDARIN VENTURE	LIBERIAN	2	54.2 N	167.6 W	00	20	M 35	10 NM	03	1006.4	9.2	5.8	9	8			
KOPAA	AMERICAN	2	12.6 N	99.9 W	15	14	35 (C)	10 NM	02	1010.5	25.6	29.4	3	11.5	14	7	16.5
MARCONAFLO MERCHANT	LIBERIAN	3	14.3 N	103.5 W	09	09	34 (C)	5 NM	03	1007.0	26.0	27.8	5	8	11	6	24.5
CRESSIDA	PANAMANIAN	3	51.4 N	135.3 W	00	23	M 40	.5 NM	47	1020.0	16.0	10.6	4	5			
PRES JEFFERSON	AMERICAN	4	37.8 N	160.9 W	00	23	40	2 NM		1024.0	18.9	18.3			29	< 6	8
MONTIRON	LIBERIAN	4	41.8 N	143.6 E	12	04	M 40	2 NM	58	998.2	16.0						
EASTERN BUILDER	LIBERIAN	4	51.0 N	154.5 W	00	23	M 35	5 NM	50	1009.0	14.0	9.0	5	8	23	9	10
CRESSIDA	PANAMANIAN	4	53.4 N	148.2 W	12	24	M 40	5 NM	50	1022.0	7.5	8.0	6	8	24	12	10
JAPAN MAIL	AMERICAN	4	33.4 N	138.0 E	00	18	50	2 NM		1002.0	24.0	25.0			18	8	16.5
SANTA MAGDALENA	AMERICAN	5	16.5 N	99.6 W	06	09	M 35	5 NM	29	1014.0	27.2	28.9	2	3	23	9	10
SANKOSUN	LIBERIAN	5	42.7 N	171.2 W	06	14	M 40	.25 NM	63	1003.0	13.0	10.0			14	9	26
SEALAND MC LEAN	AMERICAN	5	48.6 N	130.7 W	18	36	40	10 NM	02	1019.0	11.7	10.7	12	19.5			
EASTERN FORTUNE	LIBERIAN	5	49.4 N	128.4 W	18	34	M 44	10 NM	03	1017.0	12.5	12.0	5	11.5	33	8	14.5
HAWAII BEAR	AMERICAN	5	42.5 N	132.6 W	12	36	35	5 NM	60	1020.0	12.8	15.6			36	X	13
ATITLAN	SWEDISH	6	38.7 N	136.2 W	12	01	M 40	10 NM	80	1016.5	14.5	17.0	XX	11.5			
EASTERN FORTUNE	LIBERIAN	6	49.7 N	129.5 W	00	35	M 35	10 NM	01	1019.0	12.0	12.0	4	11.5			
GOLDEN RAY	LIBERIAN	6	49.6 N	129.0 W	00	34	M 36	2 NM	07	1017.5	11.7	10.0	5	13	35	9	18
PRES JEFFERSON	AMERICAN	7	37.9 N	171.7 E	00	25	35	5 NM	02	1003.7	19.0	15.5			25	10	6.5
ATITLAN	SWEDISH	7	39.6 N	140.4 W	00	01	M 36	10 NM	02	1021.5	14.8	17.0	XX	13			
PORTLAND	AMERICAN	7	52.5 N	134.6 W	00	33	40	5 NM	02	1024.7	13.3	11.3	5	6.5	33	12	10
PRES VAN BUREN	AMERICAN	7	38.8 N	176.7 W	18	18	35	.5 NM	63	999.2	17.8	15.6	8	11.5	14	8	11.5
GREEN FOREST	AMERICAN	8	11.4 N	116.2 W	06	18	35 (C)	2 NM		1010.9	25.6	27.8	2	10	18	< 6	14.5
PRES VAN BUREN	AMERICAN	8	39.3 N	171.5 W	06	19	35	.5 NM	63	1005.8	17.5	14.0	8	11.5			
JAPAN MAIL	AMERICAN	8	44.7 N	176.8 E	12	02	35	2 NM	10	994.8	8.3	9.4	6	6.5	07	6	11.5
SEALAND COMMERCE	AMERICAN	8	38.9 N	172.0 W	18	17	36	2 NM	63	998.3	16.7	15.0	4	10	17	8	16.5
PRES JEFFERSON	AMERICAN	9	36.4 N	152.3 E	06	23	35	200 YD		1009.8	22.2	20.0	2	6.5	23	6	8
TOYAMA	NORWEGIAN	9	44.0 N	164.8 W	12	18	36	200 YD	44	1013.0	14.0	11.0					
EASTERN BUILDER	LIBERIAN	11	39.5 N	147.3 E	12	27	35	5 NM	21	996.0	21.5	18.0	6	6.5	26	8	11.5
ATITLAN	SWEDISH	12	37.4 N	170.3 W	12	22	42	10 NM	02	1010.5	20.0	17.0	8	10			
LONG BEACH	PANAMANIAN	13	38.3 N	174.0 E	00	23	M 35	5 NM	60	999.0	20.0	17.0	7	13			
JAPAN BEAR	AMERICAN	13	44.2 N	165.3 W	12	20	M 48	.5 NM	45	1009.0	13.9	9.4			20	10	10
WYOMING	AMERICAN	22	37.6 N	148.1 W	12	23	40	10 NM	03	1010.0	23.2	20.0	4	13			
VAN CONQUEROR	LIBERIAN	22	50.1 N	147.4 W	00	10	M 35	2 NM	58	996.0	11.0	10.0					
HILLYER BROWN	AMERICAN	23	55.9 N	157.6 W	12	01	45	5 NM	02	999.8	10.6	10.0	2	8	01	6	14.5
PORTLAND	AMERICAN	23	58.5 N	149.8 W	18	08	40	200 YD	63	1001.5	11.2	11.2			08	12	11.5
PACPRINCESS	LIBERIAN	23	48.3 N	153.8 W	18	32	30	.25 NM		997.0	11.0	11.0			32	9	24.5
VAN CONQUEROR	LIBERIAN	23	50.0 N	139.2 W	00	15	M 40	1 NM	63	999.0	13.0	12.0					
HILLYER BROWN	AMERICAN	24	57.3 N	155.2 W	00	04	35	5 NM	02	997.8	10.6	10.0	2	8	04	7	14.5
PACPRINCESS	LIBERIAN	24	48.2 N	151.7 W	00	27	30	1 NM	10	999.0	11.0	11.0			27	9	24.5
PORTLAND	AMERICAN	25	54.7 N	139.1 W	00	17	50	.5 NM	62	1000.0	11.3	11.3	7	11.5	17	>13	19.5
ROBERTS BANK	LIBERIAN	26	27.5 N	143.0 E	18	14	M 35	10 NM	01	1008.8	27.2	28.0	3	8			
TRANSCOLORADO	AMERICAN	26	19.4 N	145.1 E	00	16	45	50 YD	82	1006.1	26.7	30.0	4	6.5	16	7	11.5
ROBERTS BANK	LIBERIAN	27	26.0 N	143.8 E	00	13	M 35	10 NM	03	1008.8	28.5	29.1	3	10			
PACIFIC CARRIER	LIBERIAN	29	39.5 N	124.3 W	06	32	35	5 NM	01	1009.0	14.4	10.5					
MANDARIN VENTURE	LIBERIAN	30	44.0 N	172.2 E	00	13	M 35	.5 NM	54	1007.6	12.8	10.0	6	6.5	12	8	16.5
NORTH PACIFIC		AUG.															
AMER ASTRONAUT	AMERICAN	2	27.5 N	125.0 E	12	07	40 (N)	5 NM	02	1003.0	27.7	28.3			07	< 6	19.5
AMER ASTRONAUT	AMERICAN	3	29.1 N	128.5 E	00	10	35 (N)	5 NM	82	1006.8	27.8	28.8			10	< 6	16.5
GRAND CARRIER	LIBERIAN	3	46.2 N	177.3 W	06	15	35	.25 NM	47	1014.5	14.0	12.0					
MANDARIN VENTURE	LIBERIAN	3	49.5 N	151.3 W	00	29	M 35	2 NM	41	1014.2	10.4	9.0	8	10			
GRAND CARRIER	LIBERIAN	4	47.4 N	170.9 W	00	14	35	1 NM	10	1026.5	17.0	12.0					
VAN FORT	LIBERIAN	6	48.7 N	147.4 W	12	26	M 35	2 NM	63	1016.5	12.0	11.0					
JAPAN BEAR	AMERICAN	6	33.8 N	123.2 W	18	34	M 42	10 NM	03	1016.3	15.6	15.6	9	10			
MARITIME ACE	PANAMANIAN	6	24.4 N	126.5 E	18	15	M 36	10 NM	02	1000.0	27.0	30.0			15	8	8
NEWARK	AMERICAN	6	50.3 N	128.7 W	18	19	35	5 NM	30	1014.6	10.6	13.3	4	5	25	< 6	1.5
TRANSCHAMPLAIN	AMERICAN	7	35.2 N	125.7 W	17	35	35	10 NM	02	1020.7	16.1	18.9	7	10			
JAPAN BEAR	AMERICAN	7	33.8 N	126.3 W	00	02	M 36	10 NM	02	1020.0	18.3	15.6	8	8			
TRANSCHAMPLAIN	AMERICAN	8	34.8 N	123.4 W	00	34	35	5 NM	05	1016.3	18.3	17.8	7	18			
J L HANNA	AMERICAN	10	39.8 N	124.5 W	12	33	36	10 NM	02	1014.2	10.6	8.3	5	14.5	35	6	24.5
OVERSEAS VALDEZ	AMERICAN	10	21.0 N	122.8 E	18	29	39 (O)	2 NM	19	997.6	27.7	28.0	5	11.5			
J L HANNA	AMERICAN	11	41.6 N	126.4 W	00	35	35	10 NM	02	1017.5	15.8	12.2	4	16.5			
PORTLAND	AMERICAN	12	57.5 N	146.9 W	12	02	35	2 NM	50	1013.2	13.3	12.7	6	10			
TOYOTA MARU #12	JAPANESE	12	39.2 N	149.7 W	00	21	M 38	1 NM	20	1010.7	21.0	21.0	6	10			
PORTLAND	AMERICAN	13	55.8 N	142.2 W	00	15	40	2 NM	50	1017.9	11.3	12.3	4	5	15	8	10
MOBIL ENERGY	BRITISH	14	26.0 N	140.0 E	18	14	M 40 (P)	5 NM	25	1007.5	27.0	28.0					
MOBIL ENERGY	BRITISH	15	25.2 N	141.8 E	00	14	M 41 (P)	5 NM	21	1011.5	26.5	28.0	3	8	15	8	11.5
MOBIL ENERGY	BRITISH	17	18.3 N	134.0 E	00	23	M 35	10 NM	02	1013.0	29.0	29.0			23	6	5
PORTLAND	AMERICAN	18	56.7 N	144.2 W	12	23	40	1 NM	51	1011.2	10.7	12.3	4	8			
CITANEL	SWEDISH	20	27.3 N	129.7 E	12	11	35 (R)	1 NM		983.0	27.0	30.0					
PRES MCKINLEY	AMERICAN	20	36.5 N	178.3 E	12	23	35	5 NM	25	1001.4	23.3	22.8	5	10			
BAY BRIDGE	SINGAPORE	21	49.9 N	157.0 W	12	12	M 35	1 NM	63	1000.7	11.0	11.0	5	8			
SKOGSTAD	NORWEGIAN	21	30.6 N	133.6 E	18	09	50 (R)	2 NM	80	983.4	24.6	28.0					
TRANSCOLORADO	AMERICAN	21	28.6 N	131.2 E	18	32	48 (R)	2 NM	81	986.1	27.2	28.3	4	11.5	32	9	19.5
MAMMOTH PINE	LIBERIAN	21	51.8 N	159.1 W	18	07	M 35	2 NM	62	1002.5	10.5	13.0	6	8			
CRESSIDA	PANAMANIAN	22	35.4 N	142.4 E	12	17	M 37 (R)	10 NM	02	1009.3	27.5	25.1	6	10			
PACIFIC WING	PANAMANIAN	22	50.5 N	146.3 W	00	14	M 35	200 YD	47	1009.0	12.0	11.0	2	6.5			
PRES HARRISON	AMERICAN	22	37.6 N	129.1 W	18	01	35	5 NM	02	1022.7	17.2	17.2	4	8	34	12	16.5
SKOGSTAD	NORWEGIAN	22	32.8 N	134.0 E	12	09	62 (R)	2 NM	80	989.5	24.6	28.0					
PRES JEFFERSON	AMERICAN	22	18.3 N	103.7 W	15	14	40 (I)	5 NM	02	1009.8	27.8	29.5	3	5	15	10	8
TRANSCOLORADO	AMERICAN	22	29.3 N	133.6 E	06	23	40 (R)	1 NM	81	989.8	25.6	27.8	4	11.5	24	8	18
PIONEER CRUSADER	AMERICAN	22	11.7 N	105.0 W	18	19	35 (I)	10 NM	81	1010.5	30.0	27.3	5	8	20	10	11.5
PHIL MAIL	AMERICAN	22	33.4 N	138.4 E	00	18	40 (R)	10 NM	02	1003.0	27.7	28.3	5	13	21	10	26
VEMA R/V	PANAMANIAN	22	40.3 N	130.7 E	18	03	35 (R)	> 25 NM	02	1003.0	24.1	23.5	2	6.5			
EXPORT CHALLENGER	AMERICAN	23	32.0 N	132.7 W	12	04	42	10 NM	03	1021.7	18.9	21.1	8	14.5			
VEMA R/V	PANAMANIAN	23	40.7 N	130.7 E	00	01	35 (R)	> 25 NM	00	1004.7	23.3	24.5	2	6.5			
PRES JOHNSON	AMERICAN	23	33.5 N	139.0 E	06	23	38 (R)	5 NM	02	1001.7	27.8	28.1	12	13	20	>13	16.5
SINCLAIR TEXAS	AMERICAN	24	43.2 N	125.1 W	18	36	40	10 NM	02	1022.0	16.2	12.7	4	10	34	8	13
WALTER RICE	AMERICAN	25	39.7 N	124.7 W	06	32	45	10 NM	02	1015.0	18.5	8.8	2	6.5	31	6	13

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C.		Sea Waves+		Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10°	Speed kt.				Air	Sea	Period sec.	Height ft.	Dir. 10°	Period sec.*	Height ft.
NORTH PACIFIC OCEAN		AUG.															
KRONOLAND	SWEDISH	26	23.8 N	155.4 E	12	21	35	2 NM	82	1002.0	27.8	28.0					
PORTLAND	AMERICAN	27	53.4 N	135.9 W	00	34	40	2 NM		1007.8	12.3	14.0	3	6.5	34	12	11.5
EXPORT CHALLENGER	AMERICAN	28	14.9 N	96.9 W	21	09	35 (K)	10 NM	01	1012.5	30.0	28.8	5	6.5			
PORTLAND	AMERICAN	28	57.1 N	145.2 W	00	31	40	5 NM	02	999.7	12.7	12.3	6	10	31	>13	14.5
PRES HARRISON	AMERICAN	30	37.3 N	157.9 E	06	09	40 (S)	2 NM	63	984.0	23.9	25.0	6	13	09	7	16.5

(C) Hurricane Carlotta
(I) Hurricane Ilsa
(K) Hurricane Katrina
(N) Typhoon Nina
(O) Typhoon Ora
(P) Typhoon Phyllis
(R) Typhoon Rita
(S) Tropical storm Susan

+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: The observations are selected from those with winds ≥ 35 kt or waves ≥ 25 ft from May through August (≥ 41 kt or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest wind speed was selected.

Rough Log, North Atlantic Weather

October and November 1975

ROUGH LOG, OCTOBER 1975--The primary storm path to affect ships was along the U. S. East Coast toward Newfoundland and thence the Denmark Strait. Eastward moving storms from central Canada feed into this path over Nova Scotia. This basically followed the central of three climatological storm paths that move from the southwest toward the northeast. Another storm track which originated north of the Azores Islands and stretched north-northeastward toward the Faeroe Islands did not have a climatological counterpart.

The monthly mean sea-level pressure pattern closely resembled the climatological pattern, but the center was slightly more intense. The Icelandic LOW was near normally placed, near 59°N, 33°W, at 999 mb versus the climatic 1001 mb. The high-pressure ridge along latitude 30°N was about 3 mb higher in central pressure. The bubble High over West Virginia was also 3 mb higher than normal as were the pressure centers over Europe.

The anomalies were larger than the central pressures would indicate because of minor variations such as troughing and ridging. The largest negative anomaly was 6 mb south of Kap Farvel and east of Belle Isle. There was also another 6-mb center near 48°N, 30°W. There was a large positive anomaly area east of the U. S. Southeast Coast with a 4-mb center near Bermuda. The largest positive centers were 10 mb over the North Sea and the Greenland Ice Cap.

The major departure of the upper-air flow from the climatological pattern was a low center near 58°N, 38°W, with associated troughing along 35°W. This plus ridging over the western European coast resulted in a southwesterly rather than westerly flow over that area. The anomalies followed the sea-level pattern with positive values off the U. S. East Coast and over Northern Europe, and negative values over the northern waters with the center near 50°N, 35°W.

Tropical storm Hallie formed late in the month off the Carolinas.

Extratropical Cyclones--Late on the 5th, a frontal wave developed and, by the 6th, had a closed center over Cape Hatteras. It moved northeastward up the coast, and by 1200 on the 7th, gales were blowing in all but the north quadrant. At 1200 on the 8th, the 978-mb LOW was about 100 mi southeast of Cape Race. The DART AMERICA was about 100 mi south of the center with 55-kn westerly winds. The swells were 30 ft. Not far away, but about 60 mi farther south, the DANILOUGRAD and KOSMONAUT GAGARIN both were pounded by 50-kn winds and seas to 23 ft.

The storm was on a northerly track, and the HAV-DRILL bored in with 50-kn winds near 54°N, 55°W, at 0000 on the 9th. The seas were 25 ft. By 1200 the pressure had fallen to 969 mb (fig. 27). The ANNA

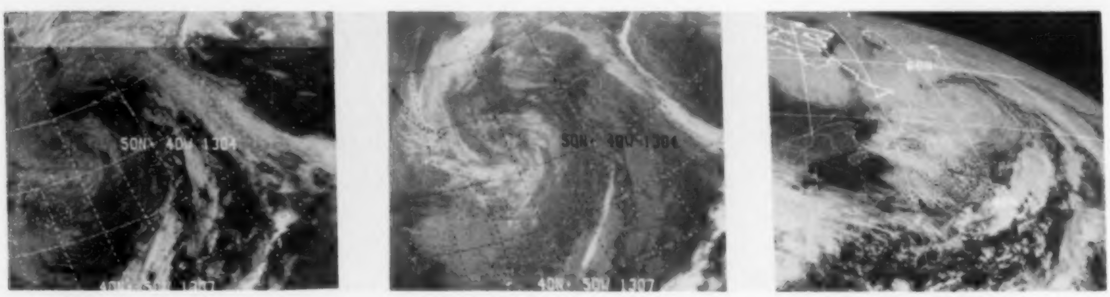

Figure 27.--Three views of the storm on the 9th. From left to right they are visual and infrared images (1304) from the NOAA-4 polar-orbiting satellite and a visual image (1700) from the stationary SMS-1 satellite.

JOHANNE and EDITH NIELSEN, both just off Kap Farvel, had 45- to 50-kn winds. Winds of the same velocity were blowing west of the center. At 0000 on the 10th, the HESSTRASHNIJ, out of St. John's, reported 40-kn winds with 20-ft seas and 34-ft swells. The HAVDRILL had 26-ft seas. The LOW had made a small loop on the 9th and 10th near 53°N, 51°W and was filling, on the 11th, as it moved eastward. By 0000 on the 12th, the pressure had risen to 1002 mb, and there were several weak centers. On the 13th, one of these developed into the major circulation center.

A frontal system out of a Canadian LOW moved southeastward across the North-Central States. At 1200 on the 11th, a LOW formed over Maryland at the point of occlusion. As it moved off the coast, on the 12th, its circulation expanded. At 1200 on the 13th, the CAP SIDERO had a stormy 45-kn wind from the south, complete with a thunderstorm. The seas were 16 ft, and swells were 18 ft, near 39°N, 57.5°W. Just a few miles away, the EXPORT DIPLOMAT (38.9°N, 58.3°W) had 40-kn gales and the same waves. On the 14th, the center moved northward over Newfoundland. Minimal gales were common. On the 16th, the storm's center turned eastward, and early on the 17th, the ALBRIGHT PIONEER (52°N, 47°W) was about 180 mi southwest of the 976-mb center fighting 60-kn winds. At 1200 (fig. 28), Kap Farvel reported 60-kn winds and snow. Far

Figure 28.--This infrared image of the storm indicates a nearly cloudless storm center. The visual image had poor reflection because of the low sun angle, but it indicated nearly the same cloud pattern.

to the east, south of Iceland, the NEW ENGLAND TRAPPER had 40-kn thunderstorm winds. At 1200 on the 18th, the HOLENDRECHT, at 50°N, 40°W, was taking 30-ft waves on the starboard quarter of her bow. At about this time a subordinate LOW developed on the east side of the circulation. It moved northwestward, as the initial LOW moved eastward, south of it. By the 20th, the initial LOW had disappeared.

Monster of the Month--The front from the previously described LOW extended to another LOW over West Virginia on the 18th. Late in the day, a wave formed on the front south of Nova Scotia. It was below an area of upper-air zonal flow and raced eastward at about 45 kn.

By 0000 on the 20th, it was 986 mb near 42°N, 36°W. In the western quadrant, the MAGDALENE VINNEN (36.5°N, 43.5°W) was blasted by 45-kn winds, and the SPEYER (41°N, 44°W) experienced 40-kn winds. By 1200 the pressure had plunged to 962 mb at 44°N, 29°W (fig. 29). Gales were blowing in all quadrants. The SPEYER was reporting regularly on her northeastward track. At 1200 she encountered devastating 46-ft seas, near 42.5°N, 41°W, although the winds were only reported as 45 kn. Not far downstream (39°N, 37.5°W), the POLARBRIS found 50-kn winds and the same devastating 46-ft seas with 49-ft swells.

At 0000 on the 21st, the LOW had continued to deepen to 946 mb. The HAHNENTOR was sailing east-

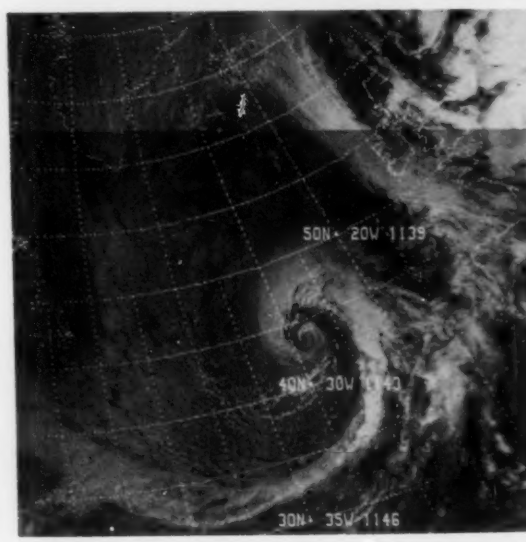

Figure 29.--The clouds spiraling into the center clearly define its location. The front is sharply outlined, as is an older front and the maximum wind band along longitude 10°.

ward at about the same speed as the LOW, which was south of her track. As the LOW turned northeastward and continued to deepen, the winds increased. At 0000 the HAHNENTOR had 60-kn winds from the north-northwest with 39-ft seas. To the southwest, the VANCOUVER TRADER had 45-kn winds with 23-ft seas and 33-ft swells. At 1200, another ship, near 48°N, 34°W, had 55-kn winds and 30-ft seas. The HAHNENTOR was still receiving 45-kn gales and 33-ft swells. Far to the west on the edge of the storm (46°N, 41°W), the LKNE found 55-kn winds with 48-ft swells.

During the 22d, the LOW was nearly stationary and slowly filling. Swells of 25 to 30 ft were still being observed west of the center. On the 23d, there were a few gale reports, and late that day the track turned northwestward. On the 24th, several centers developed, and the MAYFIELD, at 41°N, 38°W, reported hail and 50-kn winds with 33-ft swells. On the 25th, this violent storm no longer existed.

A northeast-southwest oriented front moved off the U. S. East Coast on the 30th. A large HIGH was pushing eastward over the Great Lakes. The pressure gradient west of the front was much greater than east of the front, and frontal waves were forming and dissipating. On the 31st, a ship off Cape Cod reported 40-kn winds. By 1200 an unstable wave had developed a large circulation in only a few hours. Gales were reported east and west of the front. There was a 65-kn report near 35°N, 68°W, but the wave data, cloud data, and lack of severe current weather made it suspect.

At 0000 on November 1, the 978-mb center was south of St. Mary's Bay. The BAFFIN was north of Trinity Bay with 50-kn winds and 16-ft waves. The LOW was racing northeastward and at 1200 was 974 mb (fig. 30). The TURANDOT was near 45°N, 45°W,

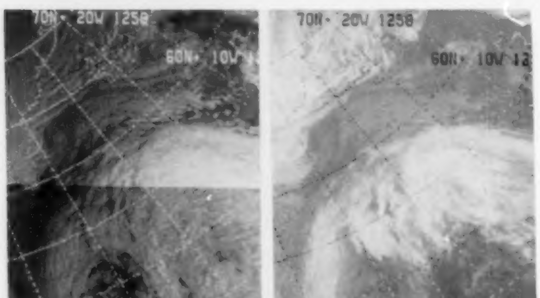

Figure 30.--The difficulty of two eyewitnesses of the same event. This was the same eye (sensor) and the same storm from two different points of view (wavelengths).

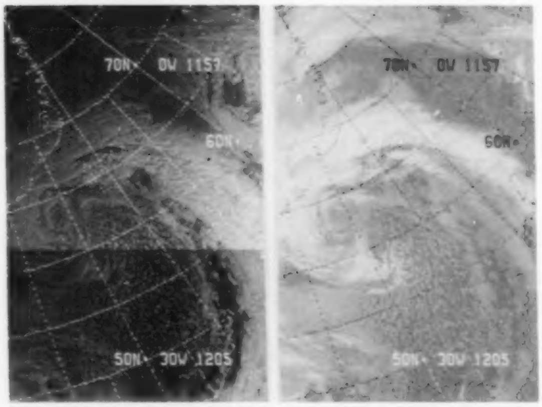

Figure 31.--The same storm 23 hr later. The visual image is very dim because of the low sun angle.

and sailing into 65-kn hurricane-force winds. The wind was driving only 13-ft seas, but the swells were 41 ft. There were three reports of 50-kn or more north, west, and south of the center by the MANCHESTER CHALLENGE, OSSENDRECHT, and another ship. The MANCHESTER CHALLENGE, at 52.4°N, 46.2°W, measured 38-ft swells.

At 1200 on the 2d (fig. 31), the 946-mb LOW was nearing the Denmark Strait. The MANCHESTER CRUSADE was 450 mi south and gently headed into 65-kn westerlies, thunderstorms, hail, and 26-ft waves. Ocean Weather Station CHARLIE found it difficult to remain on station with 40-kn winds and 33-ft waves. At 0000 on the 3d, LIMA had the same problem with the 50-kn storm. The 30-ft seas from 260° and the 23-ft swells from 220° did not make life comfortable. At 1200 survival was most important when 60-kn winds, 33-ft seas, and 30-ft swells battered Lima.

The central pressure was rising by the 4th, and a secondary center had split off north of Iceland and was moving north along Greenland's coast. Lighter winds prevailed as the LOW stalled in the broad vicinity of 65°N, 30°W, and dissipated.

Tropical Cyclones--Tropical storm Hallie was spawned by a low-pressure system that developed off the east coast of Florida late in the month. On the 25th, this broad system moved slowly northward paralleling the Florida-Georgia coast. Maximum winds of 25 to 30 kn generated 1- to 2-ft tides. On the afternoon of the 26th, the system reached tropical storm strength and was christened Hallie about 85 mi south of Wilmington, N. C. Winds near her center ran about 40 kn as she headed northeastward. They increased to about 50 kn as Hallie moved east of Cape Hatteras early on the 27th. She was heading for a collision with a cold front to the north. As she merged with this system, later in the day, she began to weaken and lose her tropical characteristics.

Casualties--The 4,851-ton British motor vessel FURUNES, Norway for Charleston, arrived Charleston on the 10th with heavy weather damage to vessel and cargo.

ROUGH LOG, NOVEMBER 1975--There were many more low-pressure centers over North America, north of 40°N, than over the ocean. The primary track of the LOWs that affected North Atlantic shipping was along the east coast toward Labrador and the Labrador Sea or the Denmark Strait. A secondary track passed over the United Kingdom from the southwest. These tracks closely paralleled climatology, except the storms that formed along the U. S. East Coast formed nearer the coast than normal. The major areas of cyclogenesis were off the U. S. East Coast, east of Newfoundland, and east of the southern part of Greenland including Iceland.

The mean pressure pattern was near the climatic normal in appearance, but the pressure centers were more intense, resulting in a much tighter gradient. The 1003-mb Icelandic Low was 998 mb near 63°N, 31°W. A 1001-mb center was over the Norwegian Sea. The 1019-mb Azores High was 1025 mb near 40°N, 20°W, which was over 600 mi northeast of its normal 35°N, 31°W, location. There was a small 1015-mb Low center over Corsica in the Mediterranean Sea.

There were three major areas of pressure anomalies. A large negative area with two 6-mb centers was south and east of Kap Farvel. A positive center that dominated the eastern ocean off Europe had an 8-mb center near 47°N, 16°W. The other area was positive with 4-mb centers and covered a large area off the U. S. East Coast.

There were significant differences in the upper-air pattern at 700 mb. The trough normally over the eastern United States was over the central region. An additional trough was located over midocean with a pronounced ridge off the European West Coast.

There were no tropical cyclones this month. On the average one will occur every 3 yr and only in 1 yr in 7 will it develop to hurricane intensity.

Extratropical Cyclones--The first half of the month was relatively quiet over the North Atlantic but not over the Great Lakes. The temperate latitudes were dominated by high pressure most of the time, and when low-pressure areas developed they were generally weak and did not produce strong winds or high waves. An exception was a large area of low pressure during the 2d week, but the gradient was weak and only isolated gales were reported.

Monster of the Month--A 999-mb LOW was analyzed over Kansas on the 1200 chart of the 9th. The LOW was moving northeastward at 25 to 30 kn, deepening and expanding as it moved. At 1200 on the 10th, the 982-mb center was near Marquette, Mich., on the southern shore of Lake Superior. By 1800, the 980-mb LOWs center had crossed Lake Superior to the vicinity of 48.5°N, 85.5°W. Shore station winds were 20 to 25 kn.

At 0000 on the 11th, the LOW was 978-mb pressure and near 51°N, 82°W (fig. 32). Its cyclonic circulation stretched north-south from Hudson Bay to Detroit. The EDMUND FITZGERALD (fig. 33) was approaching

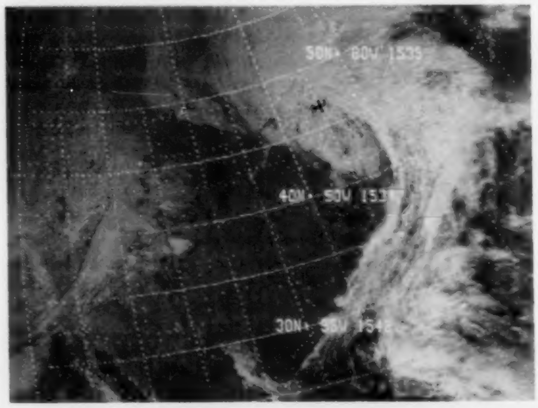

Figure 32.--At the time of this image the center of the storm was near Michipicoten Island and moving northeasterly. The plus indicates approximately where the FITZGERALD sank.

Figure 33.--The EDMUND FITZGERALD.

Whitefish Bay toward the locks at Sault Ste. Marie with 26,216 tons of taconite ore pellets. The ARTHUR M. ANDERSON was about 10 mi behind the FITZGERALD which had reported taking on water through the vents but the pumps were taking care of it. The last communication with the FITZGERALD was about 0000 on the 11th (1900 CST on the 10th). At 0025 the ANDERSON reported that all communication and radar contact with the FITZGERALD had been lost approximately 15 min earlier.

The winds over Lake Superior at the time were estimated at 40 to 45 kn with gusts to 75 kn and seas running 20 to 25 ft. The air temperature was 41°F and the water temperature 49°F.

The FITZGERALD was 729-ft long and sank in 520 ft of water about 43 mi northwest of Sault Ste. Marie with 29 crew members. None were rescued, but life saving equipment was found in the search for survivors. The ship was built in 1958. The last major ship disaster on the Great Lakes was on Nov. 29, 1966, when the DANIEL J. MORRELL broke in two during a gale on Lake Huron killing 28 crew members.

The LOW continued northeastward, and at 1200 on the 11th, the center was over the northeastern corner of James Bay. The gradient over the Lakes had weakened considerably by morning, but low clouds restricted search and rescue operations.

On the 12th, another low center moved across northern Lake Michigan and the vicious LOW stalled east of Hudson Bay to gradually fill and disappear.

The first significant storm over the open ocean formed between two large HIGHs, one over the eastern United States and the other west of the Bay of Biscay. Another LOW had developed in the same area a few days earlier and aided in the development of this LOW. At 0000 on the 18th, the 999-mb center was at 36°N, 58°W. At 1200, minimal gales were being reported, and at 0000 on the 19th, the DELTAGAS, near 33°N, 52°W, was illuminated by 45-kn winds and flashes of lightning.

As the storm moved northeastward, its circulation expanded and 35-kn gales with 10- to 15-ft waves were common reports. At 0000 on the 20th, the GEORGE WALTON was headed westward at 37.5°N, 48.5°W, with 40-kn northwesterly winds and 20-ft swells. Far to the northwest, the DART AMERICA had squalls within sight over the Grand Banks. At 1200 on the 20th, the 969-mb LOW was near 55°N, 48°W. The TEUTONIA was approximately 100 mi southeast of Kap Farvel struggling with 60-kn northeasterly storm winds at 1200 and 65-kn at 1800. The ELIZABETHPORT (37°N, 51°W) and LASH TURKIYE (39°N, 27°W) were both many miles away from the center but still were pounded by 40-kn winds. The ELIZABETHPORT had 20-ft swells and the SEALAND CONSUMER at 39°N, 50°W, had 30-ft swells.

At 0000 on the 21st, the 960-mb surface LOW was nearly vertically alined with the upper-air LOW and rotating in a circle with its circulation. The ELBE EXPRESS, at 51°N, 45°W, was sailing into 50-kn winds and 18-ft seas. The station at Kap Farvel measured 50 kn also (fig. 34).

On the 22d, the storm broke away from the upper-air LOW and raced eastward with the zonal flow. The TROLL PARK, near 45.5°N, 33°W, was treated to 50-kn winds. As the storm approached Ireland, on the 23d, it had deteriorated to only a trough.

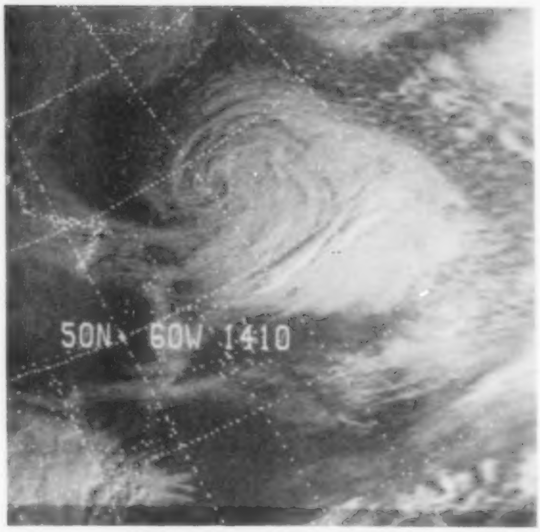

Figure 34.--The center of the storm is nearly stationary east of Labrador and south of Greenland.

This storm moved out of New Mexico on the 19th. It moved on a steady great circle track until it reached the mouth of the St. Lawrence River on the 22d. At that time, the central pressure was 992 mb. As it turned northeastward, it deepened rapidly. It was 968 mb 24 hr later near 60°N, 55°W. The C. P. DISCOVERER was north of Newfoundland with 45-kn gales. On the 24th, the LOW split on the wedge of Greenland. At 1200, the main LOW redeveloped on the east coast north of Kap Farvel (fig. 35). The VIKTOR LYAGIN was at 52°N, 49°W, and holding her bow into 65-kn west-southwesterly winds. The seas were reported as only 13 ft. Farther east, several ships reported 35- to 45-kn winds. Ocean Weather Station "C" measured 26-ft seas, and the MOSEL EXPRESS about 100 mi to the north measured 23-ft seas. At 0000 on the 25th, CHARLIE measured 40-kn and 33-ft. At 1200, the MANCHESTER CRUSADE at 56°N, 30°W, had 50-kn winds and 16-ft seas.

As the LOW moved over the south coast of Iceland on the 26th, Ocean Weather Station "L" measured 45-

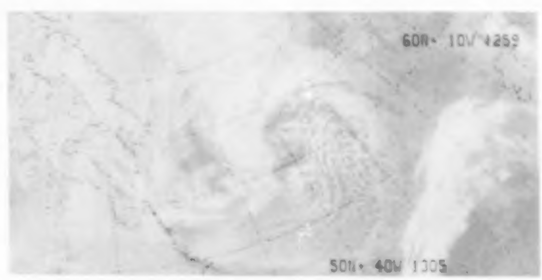

Figure 35.--Both LOWs can be seen straddling the southern tip of Greenland. The eastern one is forming, and the western one will dissipate.

kn winds, 16-ft seas, and 28-ft swells. Late on the 27th, the LOW turned northward as another LOW farther south raced eastward. This spelled the doom of the storm as the new LOW became the dominate system.

An incipient easterly wave in the trade winds was the impetus for this storm. Earlier in the year it might have developed into a tropical cyclone. The LOW was first analyzed, on the 0000 chart of the 30th, on the strength of two ship reports. At 1200, there were more ships radioing observations, and there was no doubt of its existence. The central pressure was 1004 mb and several ships reported gales. The POST CHAMPION, near 26°N, 48°W, was about 120 mi southeast of the center (27°N, 50°W) and was plotted as 60-kn from the south. A cold front was approaching from the northwest and by 0000 on December 1 was an integral part of the storm. A British ship which could not be further identified reported 45-kn winds northwest of the center. Further north, near 42°N, 45°W, the NEW ENGLAND TRAPPER was pounded by 40-kn winds and 33-ft swells on her starboard side.

A ship whose call sign appeared to be KAZQ was within 60 mi of the 987-mb center with 55-kn winds at 1200. To the northeast the BIOKOVO reported 50-kn winds. There were reports of gales in all quadrants. The highest seas were 16-ft with the EXPORT DIPLOMAT reporting 23-ft swells at 39°N, 52°W.

On December 2, the LOW was filling and moving northwestward as a 1038-mb HIGH drifted southeastward. On the 3d, a front was moving eastward off Nova Scotia and a frontal wave formed, intensified, and absorbed the older system.

Casualties--Fog over the English Channel and Bay of Biscay resulted in two collisions on the 15th. The weather in the area was dominated by a HIGH over Spain. The 13,481-ton Zaire-registered cargo and passenger ship KANANGA (fig. 36) and a Soviet trawler collided about 20 mi off Ile D' Ouessant. The KANANGA was towed to Brest. The passengers were removed by the trawler and two French fishing vessels. In the Bay of Biscay a collision between a Panamanian ship and a Spanish trawler, which sank, left four of its nine crewmen missing.

The 16,704-ton British TACOMA CITY grounded in fog, on the 21st, in Tampa Channel. Vessel was refloated with assistance of three tugs.

Later in the month, a collision in heavy rain and poor visibility between the 28,254-ton American tanker OVERSEAS JOYCE and the 926-ton Lebanese motor vessel KARIM H left the tanker holed and aground in the Dardanelles.

On the 26th, the 4,400-ton Soviet ship GORIZONT sank after a collision with a Moroccan freighter in the English Channel in poor visibility.

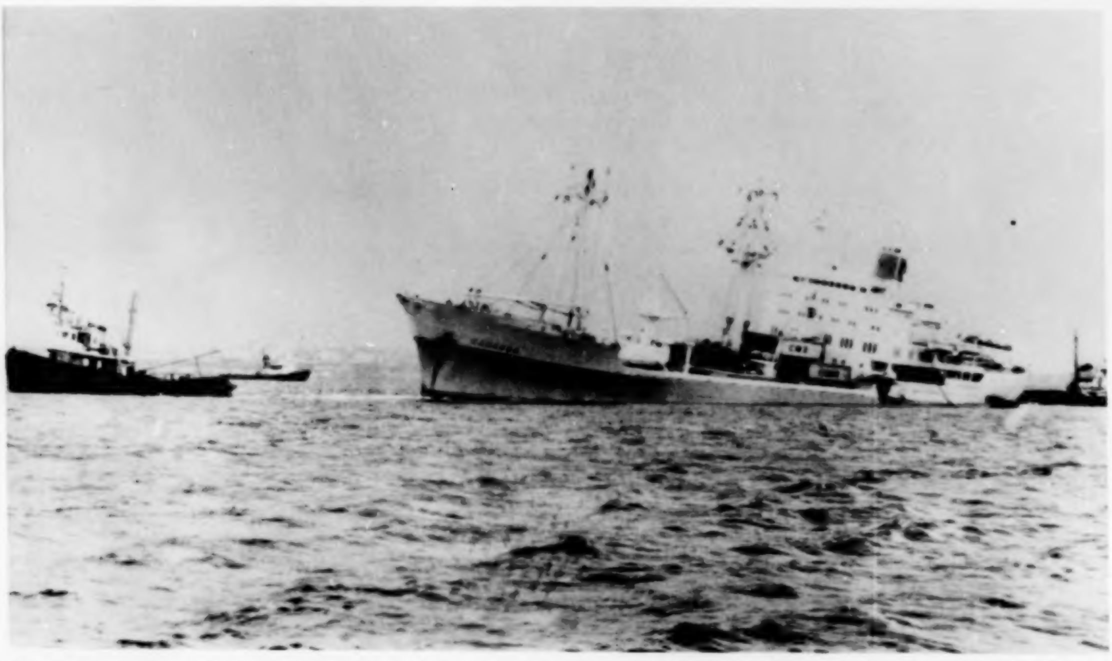

Figure 36.--The KANANGA is towed into the harbor at Brest after a collision with a Soviet trawler. Wide World Photo.

Rough Log, North Pacific Weather

October and November 1975

ROUGH LOG, OCTOBER 1975--The number of cyclone tracks appeared to be slightly below normal this month. One of the primary tracks that affected shipping originated over the southern Yellow Sea or south and east of Japan. The path was generally northeastward to the Aleutians; some storms moved into the Bering Sea and others into the Gulf of Alaska. There were secondary tracks into the Gulf of Alaska and the Canadian-United States coast. Storms that came out of the Asian Continent generally dissipated before reaching the open ocean.

The overall mean sea-level pressure pattern was near the climatological mean. The centers were normally located, but the central pressures of the Highs were above normal. The 1000-mb Aleutian Low was centered over the Gulf of Alaska near its 1001-mb climatic counterpart. The Pacific High at 1024 mb was centered north and east of Hawaii. The Asian High was 3 mb higher than the normal at 1027 mb. There were two anomalous troughs, one off the coast of the western ocean and the other off the North American coast.

The anomaly centers were not especially intense. There were three significant negative centers: a 4-mb off the Canadian coast, a 3-mb centered near 43°N, 170° E, and a 3-mb over the South China Sea. There were two significant positive centers: a 6-mb near 41°N, 157°W, and a 6-mb near Mys Navarin.

The upper-air mean pattern at 700 mb was basically zonal. There was a major trough extending from the Bering Strait to Kodiak Island and thence southeastward. There were also several minor troughs to the west. A closed High of 3202 m was near 30°N, 175°W. The anomaly centers were closely associated with the sea-level anomaly centers.

There was one hurricane--Olivia--over the eastern waters. Over the western ocean, there were two tropical storms, Doris and Grace; and three typhoons, Cora, Elsie, and Flossie.

Extratropical Cyclones--The birthplace of this storm was an old weak front across the central ocean between two large HIGHs. Weak stable waves had been moving along it for several days. Late on the 3d, a different type developed, and by 0000 on the 4th, gale-force winds were blowing. The pressure was 1002 mb near 33°N, 170°E.

At 0000 on the 5th, the 996-mb storm generated three reports of 50-kn winds (fig. 37). They were by the AMERICAN APOLLO (38°N, 174°E), the BLUE SKY (40.1°N, 178.5°E) with 30-ft seas and swells, and the TOCHIGI MARU (40.5°N, 179°E) with 20-ft swells. Twelve hours later, the HIEI MARU, 150 mi north of the center, found 23-ft waves. As the storm moved northeastward, it crossed the path of the WASHINGTON at about 0600 on the 6th, which reported 40-kn winds and 20-ft waves at 1200. Early on the 8th, the weakened storm moved northwestward across the Aleutians and was absorbed by extratropical Cora.

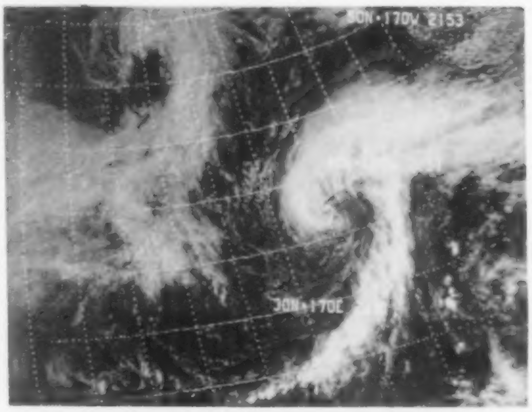

Figure 37.--At 2200 on the 4th, the storm center is near 37°N, 175°E. The cloud pattern resembles either a large "T," a comma, or a question mark depending upon one's imagination.

This was a very long-lived storm. It originated over Korea on the 7th. It gained quite a circulation as it moved over the Sea of Japan to the Tatar Strait where it stalled for 24 hr on the 9th and 10th. It also lost some of its intensity. On the 11th, it again started moving eastward and gathering strength. The first gale report was at 1200 on the 12th near 44.5°N, 159°E, east of the center. At 1200 on the 14th, a new center developed east of the old one and was to become the primary LOW within 12 hr.

By 1200 on the 15th, the new center was 970 mb at 53°N, 161°W. A ship encountered 50-kn winds along the warm front in the vicinity of 48°N, 142°W. Ocean Weather Station "P" rode out 35-kn gales. At 0000 on the 16th, the CHEVRON MISSISSIPPI was at the point of occlusion (53.5°N, 136.5°W) with 50-kn winds and 18-ft waves. Farther north the GALVESTON (57.5°N, 146.3°W) also battled 50-kn winds and 20-ft waves. The pressure was 960 mb. The circulation was now pounding the coastal mountains, and the system lost strength rapidly and could not be analyzed after 1200 on the 17th.

Reports from the NEW YORK MARU and TOYOTA MARU identified the beginning of this storm on the 14th. It was not difficult to maintain its continuity as it was moving along the major shipping lane. The first gale report on the charts was by the ROKKOHSAN MARU, at 0000 on the 16th, near 41°N, 167°E. By 0000 on the 17th, the 988-mb LOW was near 47°N, 178°E. The AGANO MARU was near 40.5°N, 173°E, with 40-kn gales and 23-ft swells. The storm's track continued east-northeastward with the highest winds

plotted south of the center and west of the cold front.

By the 19th, the 970-mb center was well into the Gulf of Alaska. The SUNBOW was sailing northeastward, near 51°N, 149°W, with 50-kn westerlies on her stern. At 0600 Ocean Weather Station "P" measured 40-kn winds and 18-ft seas. On the 20th, the storm was dissipating, but the PHILADELPHIA was hit by 40-kn starboard winds, 12-ft seas, and 30-ft swells. At 1200, the J. L. HANNA was approaching Vancouver Island with 23-ft waves pounding her starboard side. On the 21st, the LOW no longer existed.

Ocean Weather Station "T" helped locate this storm in its formative stage on the 18th. The storm was following the Kuroshio Current. At 0000 on the 20th, the 990-mb LOW was near 41°N, 155°E. The HOTAKA MARU was slightly north of the center on the 992 isobar with 55-kn easterly winds. Twelve hours later, the AGANO MARU at 39°N, 153°E, also had 55-kn winds that had shifted to the north. The waves were running about 16 ft.

The storm was traveling northeastward at 25 to 30 kn. Several ships reported 40-kn gales. Late on the 21st, the storm crossed the Aleutians into the Bering Sea. The central pressure was now 964 mb. Adak Island measured 50-kn southerly winds, and at 0000 on the 22d, Attu Island also measured 50 kn. Several ships radioed 45 kn from all except the northeast quadrant of the storm. One of these was the ASIA BRIGHTNESS, near 50°N, 176°W, with 25-ft seas.

As the LOW continued moving northeastward, it deepened to 961 mb with a tight gradient (fig. 38). The meteorological station at Mys Navarin reported 65-kn hurricane-force winds at 0000 on the 23d. A ship east of Saint George Island reported 40-kn winds, 16-ft seas, and 30-ft swells. A ship north of Unimak Island, which appeared to be the SHOYO MARU, reported swells of 23 ft.

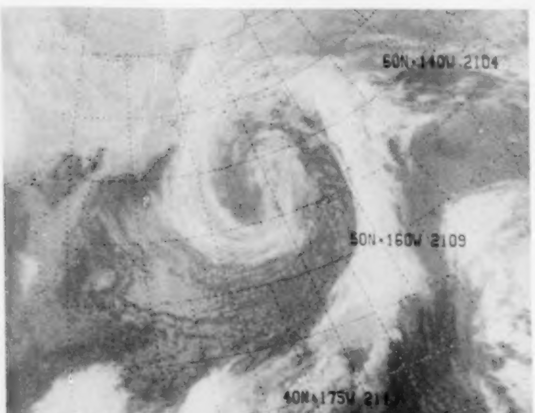

Figure 38.--A tongue of clouds has rotated completely around the storm's center as the frontal clouds have moved far east of the center. Another LOW and two frontal waves are indicated in the southwest corner of the picture.

As the center moved over Nunivak Island, its pressure was increasing, but Mys Navarin was still measuring 70-kn winds with a temperature of minus 14°C. The SHOYO MARU was now clearly reporting 40-kn winds, 16-ft seas, and 23-ft swells, north of Unalaska Island. When the LOW moved inland, it filled rapidly.

The Sea of Japan spawned this storm on the 28th. It raced northeastward under a tight upper-air zonal gradient. The KENJYU MARU was near 48°N, 163°E, in the warm sector, with 40-kn winds and 15-ft seas and swells. By 1200 on the 30th, the 974-mb storm was just off the Kamchatka Peninsula near 55°N, 164°E. A ship south of Ostrov Beringa reported 23-ft waves.

On the 31st, the storm intensified even more to 966 mb. The JAPAN MAPLE was near 49°N, 167°E, and sailing 90° to 45-kn westerlies and 33-ft waves. By November 1, the storm had turned to an easterly track and the circulation had elongated in an east-west direction in response to a similarly shaped upper-air configuration. By 1200 on the 1st, a second LOW developed near the Shumagin Islands and rapidly became the major center. The TAKAO MARU found 55-kn winds near 54.5°N, 142°W, at 0000 on the 2d. The seas were 16 ft and the swells 33 ft. At 1200, the MOBILE had 40-kn winds near 56°N, 140°W. On the 3d, the AVILA fought 50-kn bow winds with 13-ft seas and 18-ft swells 30° off the seas. At 1200, the PHILADELPHIA had only 35 kn, but the seas and swells were 20 and 23 ft, respectively. The LOW stalled in the Gulf until the 5th when it dissipated.

Moderate volcanic activity had been observed on Shishaldin Volcano (54.7°N, 164°W), 2,858 m above sea level on Unimak Island, Alaska. Activity was first noticed in mid-September. Cloud cover obscured any activity until October 6 when the clouds lifted enough to reveal more activity. A nearby volcano, Pavlof, was also smoking at irregular intervals.

A submarine volcano erupted near Torishima Island of the Izu Islands, south of Tokyo on the 2d. The eruption was witnessed by several crewpersons and passengers of the 2,600-ton ferryboat CHICHIJIMA MARU. A red and white flaming column 30 m wide shot 40 m into the air at a point 9 km south of Torishima Island.

<u>Tropical Cyclones, Eastern Pacific</u>--Satellite pictures showed three concentrated areas of thunderstorm activity near 13°N, 106°W, early on October 21. By afternoon the PORTUGAL MARU and the SAPPORO MARU, with 1006-mb pressures 120 and 200 mi from the center, suggested a circulation had formed. By 0600 on the 22d, tropical storm intensity was indicated in high seas bulletins and advisories.

Further development was slow, and movement was toward the northwest at about 12 kn to near 15°N, 111°W, by 1800 on the 22d. The circulation was well developed as indicated by reports from the PORTUGAL MARU, the SOPPORO MARU, the OCEAN HAPPINESS, and Socorro Island, all about 200 mi from the center. The storm was forecast to move west-northwestward and intensify. By 0000 on the 23d, it became apparent that the track was more northerly, and at 1800, a vessel reported east-southeasterly 60-kn winds, at 16.8°N, 109.7°W, about 75 mi northeast of the center.

The tuna boat BLUE PACIFIC ran afoul of Olivia near 17°N, 110°W, at 0000 on the 24th, reporting 75-kn winds with gusts to 90 kn and the loss of much of her deck equipment from heavy seas.

The hurricane continued curving northeastward and began to accelerate. Air Force reconnaissance at 1322 on the 24th reported southeasterly 79-kn winds at 9200 ft in the southeast wall of the elliptical eye near 20°N, 109.6°W.

Northwesterly movement of the hurricane became stable at about 12 kn. The CUFIC and a Mexican Coast Guard vessel XCIN reported 50-kn winds some distance from the center as the hurricane moved toward the coast during the afternoon of the 24th.

The hurricane moved onshore between 0400 and 0600, a few miles south of Mazatlan, on the 25th (fig. 39). Newspapers reported 50,000 people evacuated from low-lying areas before the hurricane struck; 30,000 were left homeless in and near Mazatlan, and 500 were injured and 30 killed as a result of heavy rains and 120-kn winds. Twenty of the fatalities were crewmen of three shrimp boats which were lost. Monetary losses have been tentatively set at $20 million, $4 million of which was in the beach and tourist trade.

Figure 39.--Hurricane Olivia is near Mazatlan at 0545 on the 25th. Winds of 120 kn were reported to have occurred at this time. The airport control tower had been evacuated 2 hr earlier because of the strong gusty winds.

Reports from vessels and satellite pictures made possible the positive forecasting of the storm during the 18 hr prior to its moving onshore. While damage and suffering were considerable, without the early warning they would have been greater.

Tropical Cyclones, Western Pacific--Cora came to life on the first day of the month, about 400 mi northwest of Yap Is. She became a tropical storm on the

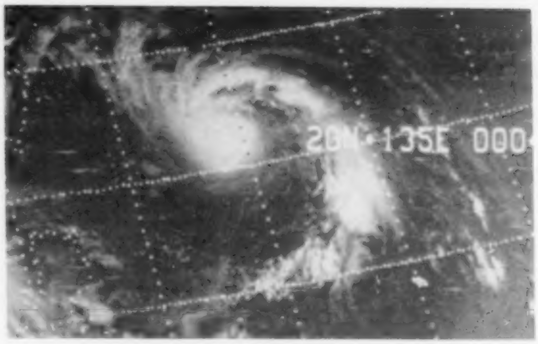

Figure 40.--Cora was near typhoon strength when she posed for this shot on the 3d.

2d. This can be attested to by the FUOSHAN MARU, which encountered 35-kn winds in 15-ft seas at 0000. Cora was moving north-northwestward at the time, but on the 3d, as a typhoon (fig. 40), she swung toward the north. She continued to intensify and paralleled the Ryukyus, to the east, on the 4th. Her center remained about 100 mi off Shikoku and Honshu as Cora continued to recurve eastward. Winds near her center climbed to a peak of 110 kn, on the 5th, as she passed very close to Hachijojima Island, south of Tokyo. Wind gusts on the island reached 130 kn. Torrential downpours added to the destruction prevalent throughout the Izu Islands. Rains totaled 5 to 8 in. There were reports of three deaths, and 79 people were injured. On Hachijojima about 3,700 of the 3,800 homes sustained some damage while roads and communication facilities were also affected. Cora continued rapidly eastward on the 6th and began to turn extratropical.

By 1200, Cora was considered extratropical but still a very intense storm with a large circulation. The ASIA HAWK was about 150 mi north of the center with 60-kn winds. The ALASKA MARU was about 200 mi north of the 972-mb center (42°N, 163°E) at 0000 on the 7th, with 65-kn winds and 23-ft waves. The HIEI MARU was 120 mi to the southwest and washed by 50-kn winds and rain and 33-ft waves.

At 1200, the pressure had dropped to 960 mb. The following ships were within 180 mi of the center: the TOKO MARU with 55-kn winds and 26-ft waves, the PACIFIC ARROW had 50-kn winds and 30-ft waves, and the TOCHIGI MARU had 50-kn winds and 23-ft waves. On the 8th, gales were reported all around the center, but the prizes were taken by the MEIKO MARU with 60-kn and 33-ft and the ALASKA MARU with 55-kn and 25-ft.

The storm slowly moved toward Bristol Bay where it moved across the Alaska Peninsula on the 13th and disappeared over the mainland on the 15th.

While Cora was moving along the Ryukyus, on the 4th, tropical storm Doris flared briefly in the South China Sea. She formed, about 180 mi east-southeast of Da Nang and headed northward. The following day winds near her center reached 50 kn with gusts to 65 kn, before she moved across the China coast, about 100 mi west of Hong Kong. This near miss for Hong Kong was a harbinger of things to come. On the 9th, Elsie came to life in the Philippine Sea about 200 mi

north of Yap Island. She travelled west-northwestward and built into a supertyphoon--first of the year. Her course took her through the Luzon Strait on the 12th. Just before entering the Strait, her maximum winds were estimated at 140 kn. With her circulation lying partly over Taiwan and Luzon, Elsie began to diminish as she moved in on Hong Kong (fig. 41). On the 14th, one of the busiest harbors in the world was nearly deserted as liners, freighters, and junks sought protection in the open seas and in typhoon shelters. Maximum winds were down to 80 kn by the time Elsie blew into southern China moving just south of Hong Kong, which suffered no casualties and only minor damage.

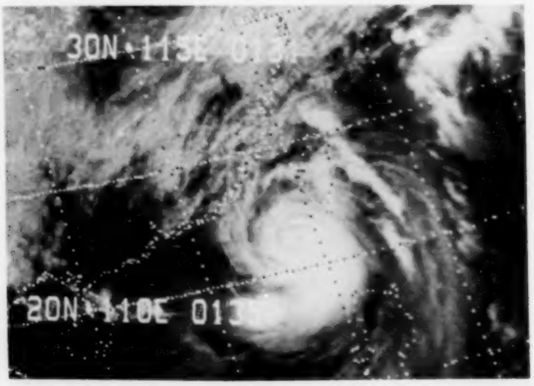

Figure 41.--Well-built typhoon Elsie is moving in on Hong Kong on the 13th.

Flossie popped up on the 20th keeping things active in the South China Sea, while Grace developed in the northern part of the Philippine Sea on the 25th. Flossie had a relatively short life as she moved northward and northwestward reaching mainland China near Chan-Chiang on the 23d. She managed to attain typhoon strength just east of Hainan on the 22d as winds climbed to more than 70 kn near her center. Two ships sank in the South China Sea, and 47 crewmen were missing including 17 aboard a lifeboat. They were the KINABALU SATU and MING SING. Three of the crewmen survived more than a week in a lifeboat before rescue. Grace meandered aimlessly for several days before finally organizing into a tropical storm on the 30th near 18.4°N, 128.5°E. From here she moved northeastward, gradually turning eastward. She reached her peak on the 31st when maximum winds climbed to 60 kn. By the 2d, Grace was becoming extratropical north of Chichi Jima.

Casualties--The 3,564-ton Panamanian freighter DENPASAR sank in rough seas 200 mi south of Tokyo on the 8th. The winds were up to 30 kn and the seas up to 15 ft. Thirteen crewmen were rescued by the HYOGO MARU and 13 were missing. The same day the 446-ton MATSUSHIMA MARU sank northeast of Tokyo in 13-ft seas when engulfed by a large wave. Four of six crewmen were rescued.

A 52-yr old woman drifted alone for a month on their yacht after her husband was lost overboard. She was rescued by the Japanese fishing vessel CHOHO MARU. The 44-ft yacht LANDFALL was taken in tow by the CHOHO MARU. The yacht had sailed from Yokosuka for Honolulu on September 2. On September 22, about 1,450 mi from Honolulu, the husband was washed overboard.

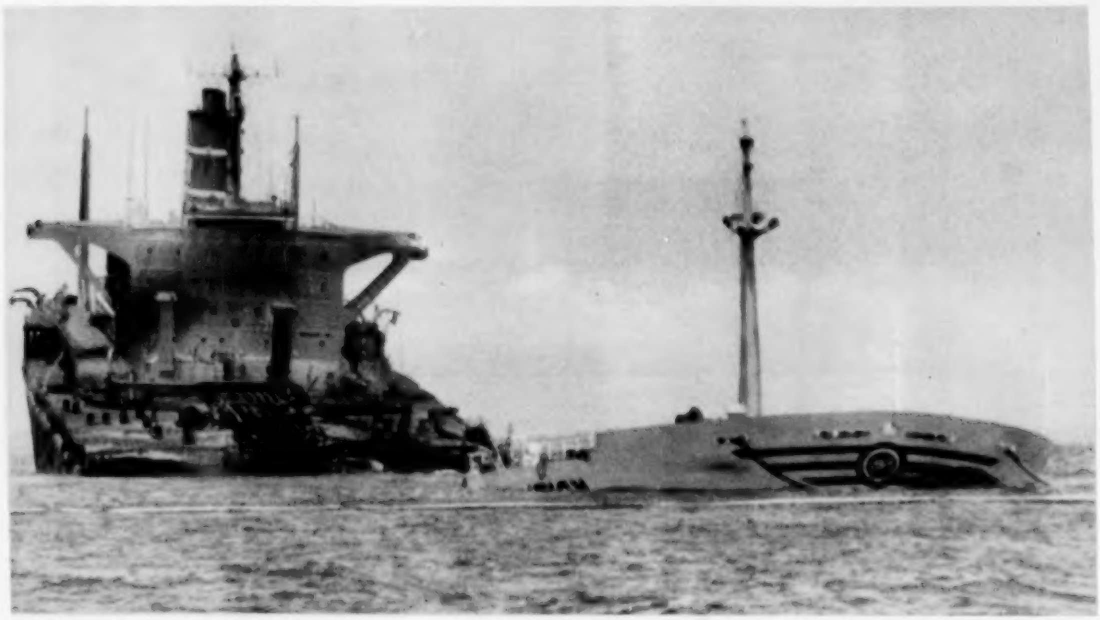

Figure 42.--The KRITI SUN lies with her center section completely under water after lightning touched off explosions that broke the vessel into three parts. Wide World Photo.

The 61,054-ton Greek tanker KRITI SUN (fig. 42) was struck by lightning at Singapore on the 28th. The ship had discharged its cargo of crude oil. The resulting explosion broke the ship's back, and the midsection sank with the bow and stern partially afloat. All crewmen and workers were rescued, but seven were injured.

ROUGH LOG, NOVEMBER 1975--The tracks of the cyclone centers were widely dispersed this month. Over the western two-thirds of the ocean, they ranged from 30° to 60°N, and from 40° to 60°N over the eastern one-third. With a little imagination, three mean tracks could be discerned. One across the Sea of Okhotsk and then northward toward Wrangel Island, another from east of Japan northeastward to the Aleutians and the Gulf of Alaska, and another from 35°N in the central ocean eastward and then northeastward to the British Columbia coast. These roughly approximated the climatological tracks.

The mean sea-level pressure pattern resembled the climatological mean in the major features. The central pressures were more intense. The Aleutian Low consisted of two centers, a 998-mb over the Gulf of Alaska and a 1003-mb over the Bering Sea. The Pacific High at 1024 mb was normally located near 33°N, 135°W. An anomalous 1021-mb High was located near 40°N, 165°E.

There were four anomaly centers that directly might have affected the weather. A minus 5-mb center was located near Yakutat on the Alaskan coast. The western coast had a positive 3-mb center. The other two major centers were positive; a 5-mb near 37°N, 135°W, and an 8-mb near 58°N, 161°E.

The most significant difference in the upper-air pattern was over the Gulf of Alaska where a short-wave trough resulted in a large negative anomaly.

There were three tropical cyclones in the western ocean: tropical storm Helen and typhoons Ida and June. In the east, tropical storm Priscilla occurred during the first part of the month.

Extratropical Cyclones--A quasi-stationary closed LOW persisted over the Gulf of Alaska for many days. An average position would be approximately 59°N, 145°W, for the period November 7-15. This was not the same storm, but a combination of many LOWs, some very short-lived, that moved into the area to reinforce the system.

One of these had a long history. It originated over the East China Sea on the 6th. On the 8th, it had a 979-mb central pressure as it moved along the Kurils with gale-force winds. At 0000 on the 10th, the VAN FORT was near 48°N, 170°E, with 50-kn westerlies. At the same time, the HOYO MARU, near 50°N, 175°E, reported 45-kn winds, 10-ft seas, and 28-ft swells. The LOW was north of the Aleutians and sweeping the islands with gales. On the 11th, the HOYO MARU (JEBE) was hit by 50-kn winds ahead of a trough out of the stationary LOW.

Various frontal waves were forming and moving around the Gulf of Alaska LOW (fig. 43). On the 12th, one of these probably was the mechanism that helped bring 65-kn typhoon-force winds to the NEWARK near 51.5°N, 133°W. The waves were reported as 25 ft.

Figure 43.--The low clouds are only faintly visible on this infrared image. A thin string of high clouds circles into the upper-air center near 57°N, 146°W.

A ship, which appeared to be the AUSTRALIS, found 38-ft swells, south of the front, near 42.5°N, 140°W.

As the East China Sea LOW moved south of the stationary center, another frontal wave formed ahead of it, and there were more high wind reports. A ship reported 60-kn winds at 49.4°N, 127.8°W, and the CRESSIDA fought 50-kn winds near 50.5°N, 130°W. The SANSINENA also battled 50-kn southerly winds at 47.5°N, 131°W. Far to the west, but still in the large circulation, the ASIA BOTAN found a 50-kn wind band. Late on the 13th, the traveling LOW was absorbed into the main system.

Another LOW was moving into the southern edge of the circulation. It had formed in midocean early on the 13th and raced eastward at about 50 kn. At 0000 on the 15th, it was 968 mb off the Washington coast (fig. 44). The CALIFORNIAN was along the front just

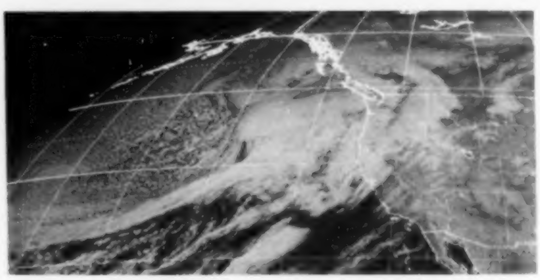

Figure 44.--The LOW can be seen in this SMS-2 image, at 1845 on the 14th, in the vicinity of 45°N, 135°W, as it raced toward the coast.

prior to the wind shift, near 45°N, 130°W, with 70-kn southerlies and 20-ft waves. To the south EB-16 measured 40-kn winds and 31-ft seas. West of the center along 45°N and between 140° and 150°W, two ships, one the ASIA BOTAN, registered 60 kn. At 1200, the CALIFORNIAN was sailing into 60 kn. The waves could not be determined from the plot, but EB-16 indicated 21 ft. The new storm was 958 mb as it struck the coast north of Vancouver Island. At this time the stationary LOW could no longer be analyzed.

This was an eastern shore, western ocean storm. It originated over the East China Sea on the 14th. It took awhile to get together as it moved across Japan, but on the 16th, it was well organized. On the 17th, it was 989 mb and moving along the Kurils. Gales were blowing ahead of the front. At 1200, the NANSHO MARU was at 48°N, 166°E, with 50-kn southerlies. By 0000 on the 18th, the LOW was 956 mb and crossing into the Bering Sea (fig. 45). Ostrov Beringa measured 80-kn winds from the north-northeast. There were many gale reports south of the center. The NANSHO MARU among others reported 25-ft waves, and the DAISHIN MARU at 41.6°N, 174.7°E, many miles south and east of the center, had 33-ft swells slapping her starboard side.

At 1200, Beringa was still measuring 80-kn; Anadyr, U.S.S.R., measured 60-kn; and Mys Navarin, 50-kn winds. The NANSHO MARU faithfully reported 50-kn and the AKAISHI MARU at 42°N, 175°E, found 55-kn winds and 23-ft waves. The SHOGEN MARU at 46°N, 179°E, was also plowing into 23-ft waves.

At 0000 on the 19th, the LOW was 960 mb with many high winds. Beringa was now 50 kn. The following ships plus Shima reported 50-kn winds southwest of the center: JUNEAU MARU, NELSON MARU, and TONAMI MARU. Far to the east in the Gulf of Alaska the AVILA experienced 50-kn easterlies.

The LOW was now being squeezed by a high-pressure system to the south and another LOW from the west. It weakened rapidly and caused no more trouble.

The sea just south of Shikoku spawned this storm on the 19th. Under the influence of upper-air flow, the storm was steered northeasterly at about 40 kn. Fed by the Kuroshio Current, it deepened rapidly. By 1200 on the 20th, the 970-mb LOW was near 45°N, 160°E (fig. 46). The following three ships reported 60-kn storm winds and waves as indicated in the southern half of the circulation: AKAISHI MARU, 30 ft (41°N, 164°E); SATSUMACORE, 33 ft (42.8°N, 157°E); and SEIRAN MARU, 16 ft (41.3°N, 158°E). Other ships reported 40- to 50-kn winds and seas to 23 ft.

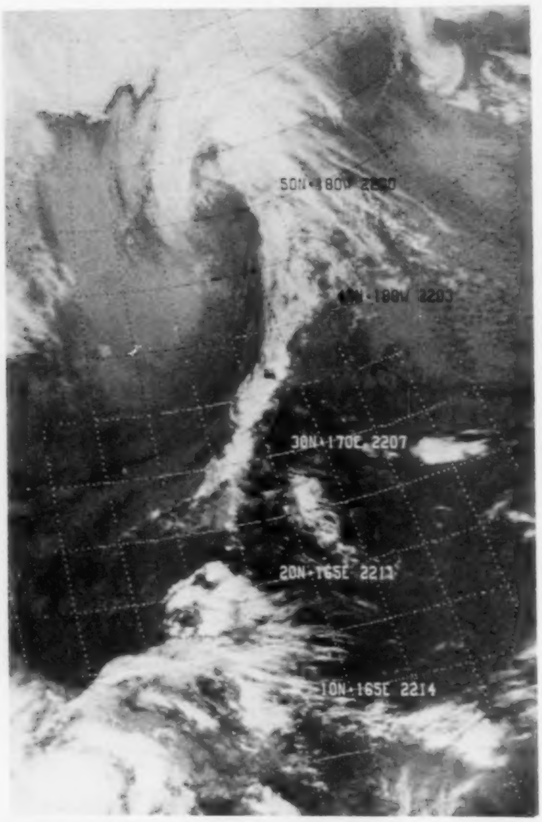

Figure 45.--The strong surface winds can be visualized in the cloud pattern.

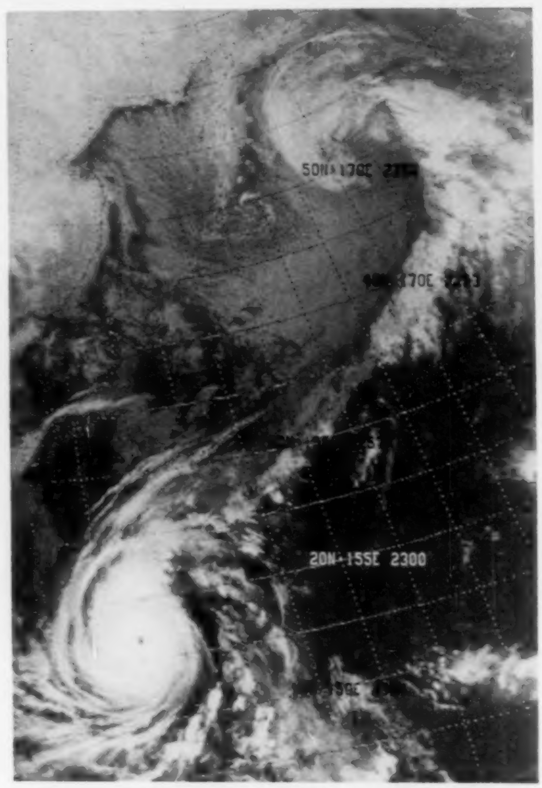

Figure 46.--At 2250, the storm center is near 51°N, 172°E. Typhoon June is churning through the Philippine Sea.

Twelve hours later at 0000 on the 21st, the 7LSP reported 75-kn typhoon-force winds at 48.7°N, 171.3°E, about 100 mi southwest of the center. The significant waves were 20 to 23 ft. Ships were observing gales to storm winds up to 600 mi distance. At 1200, many island stations measured 40-kn prevailing winds. The TONAMI MARU (50.5°N, 171.5°E) recorded 50 kn and 26-ft waves. On the 22d at 0000, the pressure was 946 mb. The PANASIA was beaten by 60-kn winds. The FREESIA, near 47.5°N, 172.5°E, reported 33-ft seas and 49-ft swells. At 1200, Adak reported a pressure of only 952 mb.

The LOW crossed the Aleutians and headed southeastward on the 22d. The JUJO MARU found 33-ft swells about 150 mi west-southwest of the center. About 400 mi due south, a ship was sailing into 36-ft swells.

Late on the 23d and on the 24th, there was an explosive filling of the LOW--36 mb in 24 hr. Late on the 24th, there was no trace of the storm.

Tropical Cyclones, Eastern Pacific--A portion of a mass of cloudiness that crossed Honduras and Guatemala during the last week in October began to organize near 11°N, 97°W. As best as could be determined, this portion of cloud remained stationary for about 18 hr and then drifted slowly north for 12 hr, gradually increasing in intensity to a depression with 30-kn winds.

As soon as a circulation was well established, the depression moved west-northwestward becoming tropical storm Priscilla at 13.2°N, 101.6°W, at about 0600 on the 4th. The track continued in the same direction, passing 120 mi northeast of the ABEL TASMAN, at 0000 on the 5th, and continued to 15.3°N, 105.6°W, with 45-kn winds by 0600 on the 5th.

The storm was forecast to continue northwestward and then curve northward, but recurvature never occurred. After 0600 on the 5th, a more westerly track developed and winds of 55 kn were estimated from satellite pictures (fig. 47).

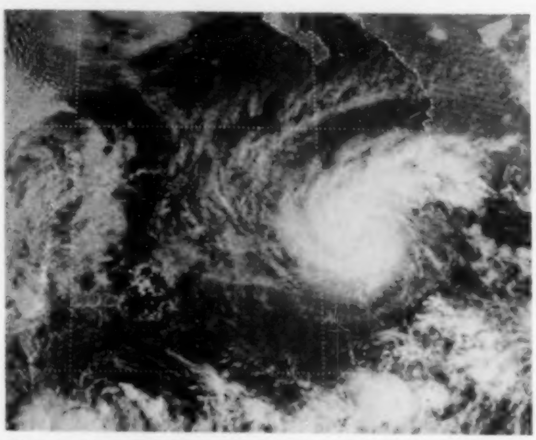

Figure 47.--The low sun angle at 1545, November 5, indicates an eye trying to form in tropical storm Pricilla. Later pictures were too well lighted to show this feature.

The Southwest Cape reported northerly 30-kn winds 75 or 80 mi west of the center near 15.6°N, 110.3°W, at 0000 on the 6th. The storm then headed northwestward toward Clarion Island but dissipated 100 mi short of landfall at 0000 on the 7th.

Tropical Cyclones, Western Pacific--Tropical storm Helen flared up briefly in the South China Sea. She was detected as a tropical storm on the 3d about 320 mi west of Manila. Moving westward and generating 35-kn winds near her center, Helen landed on the Vietnam coast near Nha Trang on the 4th.

Two days later a depression was detected about 300 mi southeast of Guam. This was the beginning of Ida. Moving northward she reached tropical storm strength on the 7th before crossing the 15th parallel. She continued to intensify while accelerating toward the north-northwest. On the 9th, she crossed the 20th parallel near 145°E and shortly thereafter became a typhoon. Ida then turned toward the north-northwest and continued to accelerate. On the 10th, she was moving at a forward speed of about 25 kn, and by the 11th this was up to 40 kn. Her winds during this period were 80 to 85 kn. The PLUVIUS at 35°N, 155°E, suffered 50-kn winds and 33-ft swells. By the 12th, she was extratropical at 40°N, 158°E. The GRAND CARRIER and TOYOTA MARU both found 50-kn winds as far as 300 mi from the center. The TOYOTA MARU had 16-ft seas (300°) and 33-ft swells (350°).

On the 13th, the central pressure of ex-Ida had risen to 994 mb, but gales were still found in all quadrants. By the 14th, the gradient would no longer support gale-force winds.

Typhoon June was the superstorm of the year. Late on November 19, an aircraft reconnaissance team reported a pressure of 875 mb. If this reading holds up under post-storm analysis, it will become the lowest pressure ever recorded at sea level. The current mark is 877 mb set in 1958 by typhoon Ida and again in 1973 in typhoon Nora.

June developed near Woleai atoll on the 1Cth. She meandered northward, but intensified rapidly. She was a typhoon by the 18th. On the 19th, maximum winds increased from 105 kn to a peak of 160 kn with 195-kn gusts. During the day she passed 200 mi to the west of Guam, which was buffeted by 43-kn winds with gusts to 55 kn. After reaching her peak intensity (maximum winds and lowest pressure) (fig. 48), June swung

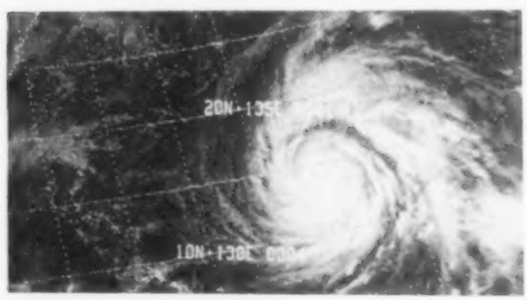

Figure 48.--June is busting out all over, very early on the 20th. She was just past her peak at this time but still well-developed.

toward the northwest. She crossed the 15th parallel on the 20th as winds began to drop. By the 22d, she began to recurve toward the north, then northeastward. The storm continued to weaken as cold air began to intrude. However, winds remained above 100 kn until the 23d, when she passed 100 mi north of Chichijima. June was turning extratropical and racing northeastward at 60 kn at this time.

On the 24th, the ANTARCTIC was not concerned with whether June was tropical or extratropical, only with the 65-kn winds she encountered about 60 mi from the center. At 1200, a strong frontal system was well entrenched into the storm, and the center had raced to 47°N, 170°E, at about 65 kn. Gale-force winds were common. On the 25th, it crossed the Chukotskiy Peninsula into the Arctic Ocean with coastal stations measuring winds as high as 55 kn.

Casualties--There were no reports of ship casualties directly attributable to weather, although there were several instances where it probably was a factor.

WE OF NOAA ARE MAKING USE OF THIS SMALL AMOUNT OF SPACE TO EXTEND OUR THANKS TO ALL THE SHIPS' OFFICERS WHO ROUTINELY TAKE SHIPBOARD WEATHER OBSERVATIONS. TO US, THESE EXCELLENT OBSERVATIONS ARE PRICELESS. WE CERTAINLY DO APPRECIATE RECEIVING THEM ON A REGULAR BASIS.

Marine Weather Diary

NORTH ATLANTIC, FEBRUARY

WEATHER. Usually the weather over the North Atlantic during February is a continuation of the storminess characteristic of January, and there are years when February weather is the most severe of winter. The average pressure distribution remains quite similar to that of January. The Icelandic Low fills to 1004 mb and is located near 60°N, 40°W. The central pressure of the Azores High drops to 1021 mb near 32°N, 22°W. This reduction in the average north-south pressure gradient is caused both by LOWs being less intense on the average during February, and by the more frequent appearance toward the advent of spring of a blocking HIGH at higher latitudes.

WINDS. Over most of the ocean north of 40°N, the prevailing winds are westerly. The winds over the Norwegian Sea are variable. North of 60°N, between Greenland and Norway, the winds vary about equally from westerly to southerly. West of the Bay of Biscay, the winds are variable. Between 25° and 40°N, the wind direction favors the southwest quadrant in the Atlantic. The direction along the Atlantic Coast of the United States is northwesterly to variable off Florida. Over the Gulf of Mexico it is northerly to southeasterly. Westerly to northwesterly winds dominate the Mediterranean Sea. Force 3 to 5 winds are the most common except off the coast of the Middle Atlantic States, where force 4 to 6 winds prevail. In the ocean bounded by approximately 45°N, 30°W, the Denmark Strait, and the Labrador Sea, force 5 to 7 prevail. The "northeast trades," 25°N to the Equator, blow 65 percent of the time with speeds of force 3 to 5.

GALES. Winds of force 8 or greater occur over 20 percent of the time in an area south of Iceland to south and east of Greenland to the Labrador Coast north of Belle Isle. Another area of gale-force winds is east of Newfoundland, centered about 48°N, 36°W, and 5° latitude in radius. Another area is over the Gulf of Lions. The 10 percent occurrence line extends from about Cabo Finisterre to about 500 mi off Cape Hatteras where it turns northeastward to parallel the coast.

EXTRATROPICAL CYCLONES. This month LOWs form most frequently 150 to 250 mi off the East Coast, from Cape Hatteras northeastward to about the latitude of Cape Cod. This is part of a large area of cyclogenesis that extends from the Gulf Coast of the United States to the Bay of Fundy. Another major area of cyclone development and the path they follow is from the Grand Banks northeastward to Iceland. There also is a primary track northward from Newfoundland to southern Greenland, where it splits into the Labrador Sea and toward Iceland. Other tracks are over the northeastern ocean from west of Ireland toward the Barents Sea, from the English Channel across the Gulf of Finland, and from the Gulf of Lions southeastward across the Mediterranean Sea. The Gulf of Genoa is also a favorite area of cyclogenesis.

SEA HEIGHTS. Seas 12 ft or higher can be expected 10 percent of more of the time north of a line from a couple of hundred miles east of Cape Hatteras to Cape Finisterre, Spain. On the Mediterranean, 10-percent frequencies lie inside an ellipse stretching from Barcelona, Spain, to Crete and then northwestward to Sicily, Sardinia, and the Gulf of Genoa. Another small area of 10-percent frequency lies between Crete and Turkey. The coast of Colombia still hosts a 10-percent line off Barranquilla. An area of over 20 percent is located off the central coast of Norway. The highest frequencies of greater than 30 percent are found over a triangular area between 57°N, 43°W; 45°N, 42°W; and 62°N, 13°W; and in the Denmark Strait.

VISIBILITY. The frequency of low visibility (less than 2 mi) reaches 10 percent or more from Halifax, Nova Scotia, northeastward to a point near 50°N, 40°W, and then northwestward to near Cape Mercy. It also reaches 10 percent on the southeastern North Sea and over the waters around the Faeroe Islands and eastern Iceland. The frequency increases to more than 20 percent inside a coastal region from Cape St. John, Newfoundland, to Resolution Island and then southward to Ungava Bay, and over the Norwegian Sea north of about 72°N.

NORTH PACIFIC, FEBRUARY

WEATHER. February weather in general can be as rough as any month of the year over the middle and higher latitudes. The average central pressure of the Aleutian Low is 1000 mb and is near 51°N, 172°E. The subtropical Pacific High is 1020 mb and centered near 31°N, 138°W. A ridge of high pressure extends eastward from the central China coast. The 1033-mb Siberian High is centered over western Mongolia. The weather regimes are controlled by these three features.

WINDS. Westerly winds prevail over much of the ocean north of 30°N and west of 180°. Northerly winds dominate the East China Sea. Winds are variable over the central Aleutians, southeasterly over the western Aleutians, and easterly near the Pribilof Islands. From the Gulf of Alaska southward to near 40°N and east of 180°, winds are mostly southerly to southwesterly, although other directions are common during the frequent passage of LOWs. Over the extreme northern Gulf of Alaska, the prevailing winds are easterly, and northerly winds are very pronounced over the Bering Sea north of 60°N. The average speed of winds north of 30°N is force 4 to 6, although east of Honshu the wind blows at force 6 or 7, 41 percent of the time. The "northeast trades" extend northward to more than 20°N over most of the western and central ocean and to 30°N over eastern waters; south of 20°N, these winds are very steady. The wind speeds in the trades range from force 3 to 5. The "northeast monsoon" is steady over the South China Sea and the Philippine Sea south of 30°N and west of 150°E. Winds are quite variable over the eastern North Pacific between 30° and 40°N, southwesterly over the east-central ocean between 30° and 45°N, and variable over west-central

waters between 25° and 30°N, and 135°E and 180°. Wind speeds over these areas usually average force 4. Northerly winds predominate over the Gulf of Tehuantepec, and in 71 percent of the observations they range between force 2 and 6.

GALES. The frequency of gales near and above 10 percent affects most noncoastal areas south of the Aleutians and north of a line from the waters southeast of Honshu to a point south of the Queen Charlotte Islands and west of Washington State. A maximum incidence of over 20 percent is found over a 200-mi-wide band 600 to 1,000 mi southeast of the southern tip of Kamchatka, an area east of northern Honshu near 37°N, 155°E, and south of the Gulf of Alaska near 52°N, 145°W. Gale-force northerly winds are encountered more than 10 percent of the time by vessels plying the Gulf of Tehuantepec off southern Mexico. These high winds occur when strong northers from the Gulf of Mexico funnel across the isthmus to the Pacific. In extreme cases, they may be felt more than 200 mi out at sea.

EXTRATROPICAL CYCLONES. The storms predominantly follow a northeasterly track. The principal areas of cyclogenesis are off Hokkaido, the East China Sea, about 600 mi south of Unimak Island, and about the same distance southwest of Vancouver Island. Secondary tracks converge 350 mi east-northeast of Hokkaido and head east-northeastward toward the Rat Islands in the western Aleutians. A primary track extends northeastward from the East China Sea to the waters south of the western Aleutians and then runs parallel to that island chain to the Gulf of Alaska. The passage of LOWs over the Gulf of Alaska along the track described above and the one entering from the southwest is more confined to the western portion of the Gulf. The storm path approaching Vancouver Island from the southwest does not contain a maximum concentration of individual cyclones until it reaches a point 600 mi from that island.

TROPICAL STORM activity is at the annual minimum during February. On the average, one can be expected every 4 yr over western waters. As in the other winter months, the principal region of cyclogenesis is east of the central and southern Philippines. Two out of every seven February tropical storms has reached typhoon intensity in the past.

SEA HEIGHTS. Seas of 12 ft or more are encountered from 10 to 20 percent of the time over most of the ocean area between latitudes 30° and 52°N from 140°W to 145°E. A small area with a similar frequency lies over the waters bounding Taiwan where the "northeast monsoon" blows strongly and steadily. Areas of 20- to 30-percent frequency extend between latitudes 44° and 49°N from 172°E to 153°E, and farther southeast 100 to 200 mi around a line drawn from 35°N, 165°E to 40°N, 175°W.

VISIBILITY. Areas of limited visibility (less than 2 mi) occur in more than 10 percent of the observations north of a line drawn from the Yellow Sea through the Sea of Japan, south of Hokkaido, and then east-northeastward to the Alaska Peninsula. A maximum frequency of over 30 percent surrounds the waters around Ostrov Paramushir, south-southwest of Kamchatka.

NORTH ATLANTIC, MARCH

WEATHER. March is a transition month. The weather retains many of the wintry aspects of January and February and at the same time begins to exhibit some features typical of spring. During the first part of March, the weather is generally a continuation of winter conditions, gradually approaching springlike characteristics near the close of the month. However, wide variations from the climatic averages may be expected, and this pattern is not always the rule. The Icelandic Low (1005 mb) rests southeast of Kap Farvel near 58°N, 40°W, while the Azores High contains two 1020-mb centers southwest of the Azores near 27.5°N, between 35° and 42°W.

WINDS from westerly quadrants generally prevail over the major part of the western North Atlantic north of 30°N. Northerly or northeasterly winds blow more often over the waters between southern Greenland and western Iceland than any other winds from the four cardinal and four intercardinal points of the compass. Winds shift to a southerly component as one moves eastward from 35°W and to variable in direction over the Norwegian Sea east of 5°W. Near the coasts of Morocco and Portugal, northerly winds predominate. South of 30°N, the "northeast trades" are the dominant winds over most of the ocean with few exceptions. East of the Florida coast to about 68°W, wind directions are southeasterly to southerly. There is a strong tendency for easterly and southeasterly winds over the Gulf of Mexico. Over the Mediterranean, westerly to northwesterly winds prevail. For the month as a whole, winds of force 4 to 6 prevail north of 40°N (north of 35°N, west of 40°W) and force 3 to 4 south of 40°N (south of 35°N, west of 40°W).

GALES (force 8 or higher) tend to decrease in strength and frequency during the latter half of March. On the average, gale-force winds have been noted in 10 percent of the ship observations north of a line extending roughly from Cape Hatteras to the Bay of Biscay, excluding the southern Norwegian Sea, the waters south of western Iceland down to 60°N, the seas west of southern Ireland to about 33°W, and the waters east of Newfoundland. A small area of gale frequencies greater than 10 percent covers the Gulf of Lions. The maximum frequency of gale occurrence, 20 percent, may be expected from the southern tip of Greenland south to about 55°N and between 40° and 50°W.

EXTRATROPICAL CYCLONES. Principal storm tracks head from the Great Lakes and the Carolina coast to Newfoundland. From Newfoundland, a primary track curves northward to the west coast of southern Greenland, and another track runs northeastward to Iceland and then into the Barents Sea. Over the Mediterranean area, a primary track extends from the Bay of Biscay east-southeastward to the southern Turkish coast.

TROPICAL CYCLONES. Only one tropical storm, a hurricane in the Lesser Antilles in 1908, has been reported in the North Atlantic in the past 104 yr.

SEA HEIGHTS of 12 ft or more are encountered more than 10 percent of the time north of a line from about 150 mi east of Cape Hatteras to Brest, France; in a small area northwest of Barranquilla, Colombia; in the Strait of Otranto between Italy and Albania; and from the coast of Sardinia northwestward to France. A large irregularly shaped area of 20-percent frequency lies in the open ocean bounded roughly by the following coordinates: 60°N, 55°W; 68°N, 25°W; 60°N, 10°W; 43°N, 43°W. Smaller areas of 20-percent frequency lie northeast of Bermuda, west of central Norway, and in the Gulf of Lions.

VISIBILITY less than 2 mi occurs 10 percent or more of the time over a 400-mi-wide elliptically shaped area extending northeast-southwest from 55°N, 40°W to 42°N, 58°W; over an area of the Labrador Sea from Cape Mercy to Cod Island; over the North Sea from southern Norway southeastward to Denmark and Sweden; and north of a line extending from southern Greenland to north of Iceland and then to the Barents Sea.

NORTH PACIFIC, MARCH

WEATHER. March is normally considered one of the transitional months between winter and spring over the North Pacific. Compared to the North Atlantic, weather improvement is somehwat delayed by the vast expanse of the ocean and the lingering winter climate over Siberia. Stormy weather is about as frequent as in the preceding month along the northern routes, especially from the western Aleutians southwestward to the vicinity of Japan. The 1005-mb Aleutian Low lies about 250 mi south of the Komandorskiye Islands and the Pacific High (1022 mb) rests near 33°N, 144°W.

WINDS. From about 40° to 60°N, winds from the westerly quarter are most frequent, although winds are variable north of the Aleutians and easterly over the Gulf of Alaska. In 40 to more than 60 percent of the observations, the wind force is 4 to 6. However, near the North American coast the most frequent wind speeds are force 4 to 5. West to north winds are most prevalent in Japanese waters south of 40°N where more than 50 percent of all winds vary between force 4 and 6. During March, the northeast monsoon continues to prevail along the Asiatic coast south of Shanghai and over Philippine waters. From 25° to 40°N, wind directions are variable, and the force is from 3 to 5 more than 50 percent of the time. The "northeast trades" are the dominant winds from 25°N to the Equator and extend northward to about 30°N over the eastern part of the ocean. The usual wind speeds, force 3 to 5, persist more than 60 percent of the time over the ocean area under the influence fo the trades. Northerly force 2 to 3 winds blow 40 percent of the time over the Mexican waters out from the Gulf of Tehuantepec.

GALES. In the central and western North Pacific, gales may be expected as far south as 30°N. In this area, north of 35°N and west of 175°W, 10 to more than 20 percent of ship reports contain winds of force 8 or higher. Over the eastern part of the ocean east of 175°W, there is a large reduction in gale frequencies compared to February, and occurrences are generally confined to latitudes north of 35°N. Percentage frequencies of gales in the central Gulf of Alaska, 10 to 20 percent in the preceding month, drop to 5 to 10 percent during March. Gales over the Gulf of Tehuantepec may be expected more than 5 percent but less than 10 percent of the time.

EXTRATROPICAL CYCLONES. The greatest frequency of cyclogenesis in the Northern Hemisphere takes place in the area off the Ryukyus in March. These storms run northeastward to an area about 250 mi east of Hokkaido where they join another primary track coming from La Perouse Strait between Sakhalin and Hokkaido. East of Hokkaido, the primary paths head northeastward to the western Aleutians where they either continue into the eastern Bering Sea or curve to the east-northeast and parallel the Aleutians and Alaska Peninsula until reaching the Gulf of Alaska. Another track extends from 50°N, 160°W, to the Gulf of Alaska. A storm track heads east-southeastward from the Gulf of Alaska to the Alaska Panhandle.

TROPICAL CYCLONES are infrequent during March. A tropical storm can be looked for once every 2 yr over the western ocean. Half of these tropical storms develop further into typhoons. Tropical cyclones during March usually sprout up east of the central and southern Philippines and west of 170°W.

SEA HEIGHTS of at least 12 ft occur more than 10 percent of the time in a somewhat rectangular area bounded approximately by 50° and 33°N, and 155°E and 140°W.

VISIBILITY. The southern limit of 10-percent frequency of low visibility (less than 2 mi) extends from Mys Alevina, Siberia, southward to 42°N, 160°E, and then northeastward to west of Kodiak Island. This frequency increases to more than 20 percent from the waters around the northern Kurils northeastward to the Komandorskiye Islands and then northwestward to Mys Ozernoy.

GLOSSARY

GLOSSARY OF METEOROLOGICAL TERMS USED IN THE SMOOTH LOGS, ROUGH LOGS, AND THE MARINE WEATHER DIARY

From time to time as space permits a glossary defining some of the more technical meteorological terms used in the monthly weather summaries will appear in the Mariners Weather Log. This glossary will contain words or groups of words which your editor feels are the most difficult to grasp.

The set of terms appears in alphabetical order. Should omissions occur, we will be happy to define any other troublesome expressions which are brought to our attention.

Alberta LOW--A LOW centered on the eastern slope of the Canadian Rockies in the province of Alberta, Canada.

Formerly, it was thought that such LOWS actually originated (more or less independently) over this location. It is now recognized that depressions moving inland from the Pacific are the actual parent systems. Alberta LOWS appear as these systems enhance, or are enhanced by, the dynamic trough, which is a typical, almost semipermanent, feature of this region.

anomaly--the deviation from normal of pressure, temperature, precipitation, etc., in a given region over a specified period.

anticyclone (High or HIGH)--a closed atmospheric circulation containing higher pressure than its surroundings, having a sense of rotation opposite to that of the earth's rotation : that is, clockwise in the Northern Hemisphere, counterclockwise in the Southern Hemisphere, undefined at the Equator.

backing--a change in wind direction in a counterclockwise sense (e.g., south to southeast to east) in either hemisphere of the earth; the opposite of veering.

center of action--any one of the semipermanent Highs and Lows that appear on mean charts of sea level pressure. The main centers of action (differentiated in the text from all-capitalized synoptic-type LOWS and HIGHS by capitalization of only initial letters) in the Northern Hemisphere are the Icelandic Low, the Aleutian Low, the Azores High, the Pacific High, the Siberian High (in winter), and the Asiatic Low (in summer). Fluctuations in the nature of these centers and other less intense systems are intimately associated with relatively widespread and long-term weather changes.

cold front--any nonoccluded front, or portion thereof, that moves so that colder air replaces warmer air; i.e., the leading edge of a relatively cold air mass.

Colorado LOW--A LOW which makes its first appearance as a definite center in the vicinity of Colorado on the eastern slopes of the Rocky Mountains. It is, in most aspects, analogous to the Alberta LOW.

convection--atmospheric motions that are predominately upward vertical, resulting in vertical transport and mixing of atmospheric properties, sometimes producing convective clouds; e.g., cumulus.

cut-off LOW--a cold LOW in the upper atmosphere which has become displaced out of the basic westerly current, and lies to the south of this current.

cyclogenesis--any development or strengthening of cyclonic circulation in the atmosphere; the opposite of cyclolysis. It is applied to the development of cyclonic circulation where previously it did not exist (commonly, the initial appearance of a LOW or trough), as well as to the intensification of existing cyclonic flow. While cyclogenesis usually occurs together with deepening (a decrease in atmospheric pressure), the two terms should not be used synonymously.

cyclolysis--any weakening of cyclonic circulation in the atmosphere; the opposite of cyclogenesis. Cyclolysis, which refers to the circulation, is to be distinguished from filling, an increase in atmospheric pressure, although the two processes commonly occur simultaneously.

cyclone (Low or LOW)--a closed atmospheric circulation containing lower pressure than its surroundings, having a sense of rotation the same as that of the earth's rotation : that is, as viewed from above, counterclockwise in the Northern Hemisphere, clockwise in the Southern Hemisphere, undefined at the Equator.

cyclone family--a series of wave cyclones occurring in the interval between two successive major outbreaks of polar air. The series travels along the polar front (the front separating air masses of tropical and polar origin), usually eastward and poleward.

Typically, the polar front drifts eastward and equatorward, so that each cyclone of the family has its origin and trajectory at a lower latitude than the previous cyclone.

dynamic trough (lee trough)--A pressure trough that forms on the lee side of a mountain range across which the wind is blowing almost at right angles; often seen on U.S. weather maps east of the Rocky Mountains, and sometimes east of the Appalachians, where it is less pronounced.

Its formation may be explained by the warming owing to the compression of the sinking air on the lee side of the mountain range, or by the generation of cyclonic circulation (cyclogenesis) caused by the horizontal convergence associated with the vertical stretching of air columns descending the lee slope.

extratropical--typical of occurrences poleward of the belt of tropical easterlies. When applied to cyclones, this term refers to the migratory frontal cyclones of middle and high latitudes.

filling--an increase in the central pressure of a pressure system. The term is commonly applied to a LOW (Low) rather than a HIGH (High).

meridional--longitudinal, northerly or southerly; opposed to zonal.

mistral--a north wind which blows down the Rhone Valley south of Valence, France, and then over the Gulf of Lions. It is strong, squally, cold, and dry. A general mistral usually begins with the development of a depression over the Tyrrhenian Sea or Gulf of Genoa with an anticyclone advancing from the Azores to central France. It often exceeds 50 kt; it reaches 70 kt in the lower Rhone Valley and 40 kt at Marseilles, decreasing both east and west and out to sea. A general mistral usually lasts for several days, sometimes with short lulls. It is most violent in winter and spring, and may do considerable damage.

monsoon--a name for seasonal winds. It was first applied to the winds over the Arabian Sea, which blow for 6 mo from the northeast and for 6 mo from the southwest, but it has been extended to similar winds in other parts of the world. The monsoons are strongest on the southern and eastern sides of Asia, the largest land mass, but monsoons also occur on the coasts of tropical regions wherever the planetary circulation is not strong enough to inhibit them. The primary cause of a monsoon is the much greater annual variation of

temperature over large land areas compared with neighboring ocean surfaces, causing an excess of pressure over the continents in winter and a deficit in summer, but other factors such as the relief features of the land have a considerable effect.

northeast trades (trade winds, trades)--the wind system, occupying most of the Tropics of the Northern Hemisphere, which blows from the Azores High or Pacific High toward the equatorial trough; a major component of the general circulation of the atmosphere.

The trade winds are best developed on the eastern and equatorial sides of the great subtropical highs, especially over the Atlantic. They begin as north-northeast winds at about latitude 30° in January and latitude 35° in July, gradually veering to northeast and east-northeast as they approach the Equator. Their southern limit is a few degrees north of the Equator. Over the Pacific, the trade winds are properly developed only in the eastern half of that ocean.

The northeast trades are characterized by great constancy of direction and, to a lesser degree, speed; the trades are the most consistent wind system on earth.

norther--in the southern United States, especially in Texas (Texas norther), in the Gulf of Mexico, in the Gulf of Panama away from the coast, and in Central America (norte), the norther is a strong cold wind from between northeast and northwest. It occurs between November and April, freshening during the afternoon and decreasing at night. It is a cold air outbreak associated with the southward movement of a cold anticyclone. It is usually preceded by a warm and cloudy or rainy spell with southerly winds. The norther comes as a rushing blast and brings a sudden drop of temperature of as much as 25° F. in 1 hr or 50° F. in 3 hr, in winter.

occluded front (occlusion)--a composite of two fronts, formed as a cold front overtakes a warm front or quasi-stationary front. This is a common process in the late stages of wave cyclone development.

prevailing wind--the wind direction most frequently observed during a given period.

primary cyclone--any cyclone, especially one associated with a front, within whose circulation one or more secondary cyclones have developed. See secondary cyclone.

quasi-stationary front (LOW)--a front or LOW which is stationary or nearly so. Conventionally, one which is moving at a speed less than about 5 kt is generally considered to be quasi-stationary.

ridge (wedge)--an elongated area of relatively high atmospheric pressure, almost always associated with an area of maximum anticyclonic curvature of wind flow, similar to a high but not containing its closed circulation.

secondary cyclone--a cyclone which forms near, or in association with, a primary cyclone.

supertyphoon--a typhoon which attains sustained wind speeds of 130 kt or more.

tehuantepecer--a violent squally wind from the north or north-northeast in the Gulf of Tehuantepec (south of southern Mexico) in winter. It originates in the Gulf of Mexico as a norther which crosses the isthmus and blows through the gap between the Mexican and Guatamalan mountains. It may be felt up to 100 mi out at sea.

triple point--a junction point of three distinct air masses, considered to be an ideal point of origin for a cyclone; i.e., near the junction of an occluded front, cold front, and warm front.

tropical--typical of occurrences within the belt of tropical easterlies. When applied to cyclones, refers to a cyclone that originates over the tropical oceans. At maturity, the tropical cyclone is one of the most intense and feared storms of the world; winds exceeding 175 kt have been measured, and its rains are torrential.

By international agreement, tropical cyclones have been classified according to their intensity as follows : a) tropical disturbance, having a slight surface circulation and one closed isobar (a line of equal or constant pressure) or none at all; b) tropical depression, with winds equal to or less than 33 kt, and with one or more closed isobars; c) tropical storm, with winds of 34-63 kt; d) hurricane or typhoon, with winds of 64 kt or higher.

trough--an elongated area of relatively low atmospheric pressure similar to a low but not containing its closed circulation. As portrayed on a Northern Hemisphere synoptic chart, a trough in midlatitudes normally dips southward. In low or very high latitudes, troughs (inverted) usually push northward.

veering--a change in wind direction in a clockwise sense (e.g., south to southwest to west) in either hemisphere of the earth; the opposite of backing.

wall cloud--the doughnut-shaped ring of clouds surrounding the eye of a fully-developed tropical cyclone. The strongest winds and the largest pressure gradient are usually found here.

warm front--any nonoccluded front, or portion thereof, which moves in such a way that warmer air replaces colder air.

warm sector--that area, within the circulation of a wave cyclone, where the warm air is found. It lies between the cold front and warm front of the storm; and, in the typical case, the warm sector continually diminishes in size and ultimately disappears (at the surface) as the result of occlusion.

wave cyclone--a cyclone which forms on and moves along a front. The circulation about the cyclone center tends to produce a wavelike deformation of the front. The early stage in the development of a wave cyclone or a poorly developed wave cyclone is called a wave disturbance.

zonal--latitudinal; easterly or westerly; opposed to meridional.

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